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THE MANUFACTURE OF EMERY WHEELS.*

By WALDON FAWCETT.

THE past few years have witnessed a surprising extension of the scope of usefulness of emery or corundum wheels. Not only has this included the use of abrasives in the manufacture of agricultural implements and in other equally well-known spheres, but it has extended to their employment in more unusual activities, such as the finishing of the leather for suede gloves, the cutting of glass, and the grinding of the edges of lenses for eye glasses. As a natural result, the industry of manufacturing emery wheels has attained additional importance, and the American factory which now produces more emery wheels than any other single establishment in the world, gives employment to three hundred and fifty persons. Very few wheels are now made entirely of natural corundum. Such was the case some years ago, when Georgia corundum from the celebrated Laurel Creek mine was plentiful, but this source was exhausted some years ago, and since that time very few of the wheels have been made wholly of natural corundum, unless constructed especially for unusual work. In place of the old type of wheel, there are now utilized wheels either composed entirely of emery or of part emery and part corundum, according to the work required of them.

Great plants are also maintained at Niagara Falls for the production of artificial corundum, practically the entire output of which is used by the manufacturers of corundum wheels. This artificial corundum is, for the manufacture of the general type of wheel, superior to any other abrasive yet produced, whether naturally or otherwise.

The raw material from which the

*Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT

PACKING EMERY WHEELS FOR SHIPMENT.

SHAVING AN EMERY WHEEL.

INTERIOR OF EMERY-WHEEL KILN.

TESTING AN EMERY WHEEL.

MIXING-ROOM OF AN EMERY-WHEEL FACTORY.

THE MANUFACTURE OF EMERY WHEELS.

artificial corundum is evolved, is placed in an electrical furnace and subjected to intense heat, the product being pure crystal corundum. The furnace is operated continuously for several hours, until there is produced a pig or mass weighing a ton or more. After the casings have been removed from the furnace and the mass of corundum is cool enough to permit of handling, it is broken up into lumps and shipped to the emery-wheel manufactories.

The first step in the evolution of an emery wheel is found in crushing, cleaning, and grading of the corundum. A mill of special design is usually provided for crushing the emery and corundum ore. The lumps are first put through a large crusher, and then through a small one, whence they make their way through various series of rolls, each set of which reduces the size of the fragments. The material then passes to washers, where it is cleaned, and from these is transferred to an automatic drying machine, where it remains until thoroughly dried. Finally, there comes the grading, which is accomplished by means of sieves, which separate the material into thirty different sizes of grains. In order to indicate the range of these, it may be explained that the coarsest grains are made by passage through a sieve which has twelve meshes to the square inch, whereas the smallest grains are secured by the use of sieves which have two hundred meshes to the square inch. The crushing mill in all its functions is entirely automatic, the material not being dependent upon manual labor for any step in the evolution from the time it enters the mill until it falls from the sieves into the storage casks.

Emery and corundum wheels are manufactured by three different processes, known technically as the "vitrified," "silicate or semi-vitrified," and the "elastic." By the vitrified process the emery or corundum is mixed with clays of different kinds, and is then subjected to a very high temperature. For what might be designated as the highest class of operations, in which such wheels are employed, those made by the vitrified process are particularly desirable. In the first place, it is possible to use only the purest and best quality of emery and corundum, inasmuch as materials of inferior grade will not withstand the high temperature. Then, too, the bond by which the particles of the wheel are held together has abrasive properties, so that every particle of the wheel cuts when it is in use. The wheels are not subjected to any pressure or tamped, and are therefore porous and open. They are necessarily waterproof after passing through such intense heat, and can be subjected to the action of either water or oil. Finally, because of their porosity, they are cool cutting, which is valuable in operations in which there is danger of drawing temper.

Wheels made by the vitrified process are mixed in great caldrons or kettles, and are subjected to a heat approximating 2,800 degrees, the kilns employed for this phase of the operations being very similar in general design to those employed at potteries. For many classes of work the wheels manufactured by the "silicate or semi-vitrified process," are just as satisfactory as those produced by the first-mentioned method. In the manufacture of the silicate wheels, silicate of soda is used as the principal bond. After the mass has been mixed, it is tamped into iron molds, and the wheels are then placed in a drying oven for a period of twenty-four to thirty-six hours, after which they are ready to be "trued" to size and shape.

The "elastic" wheels have some valuable qualities for special purposes. They possess the quality of elasticity to a high degree, and are consequently particularly valuable for operations requiring very thin wheels of large diameter. Such wheels can be run in caustic soda, and are especially adapted for work on soft steel or steel of low carbon. The elastic wheels are manufactured by what is known as the shellac process, the principal bond employed being shellac. By this process the mass, after being placed in the mold, is either rolled by means of hand rollers or subjected to hydraulic pressure. The interim, during which they are allowed to remain in the drying oven, is practically the same as in the case of the silicate wheels.

When the vitrified wheels come from the kilns, and the silicate and elastic wheels from the drying-ovens, they are taken to the truing-room, where they are placed on special machines, and the sides and faces of the wheels are made uniform. The holes in a majority of the wheels are bushed with a soft lead bushing, to protect the mandrels or arbors on which they are mounted. After having been centered and trued, all the large wheels are carefully balanced. After this has been done, there remains only the testing, which is, however, from a scientific standpoint, one of the most interesting features of the entire process of manufacture.

Each wheel is mounted on a testing machine, and subjected to three times the recommended speed suggested for the wheel when in actual use. While undergoing the test, the wheel is completely surrounded by an iron case. While on the testing machine, each wheel is run at the rate of at least 9,000 periphery feet per minute, giving it a stress of 250 pounds per square inch. In actual use the wheels are supposed to run at a rate of 5,000 feet per minute, or 75 pounds per square inch, without the application of work. The testing machines are connected with tachometers, which accurately register the number of revolutions at which each wheel is tested. The manufacture of emery wheels is not what would be termed in this age a rapid process, inasmuch as about four weeks is required to turn out a representative wheel by means of the vitrified process.

COLLECTING RARE SEEDS AND PLANTS FOR THE AGRICULTURAL DEPARTMENT.

By Guy E. Mitchell.

For several years the Secretary of Agriculture in his annual reports has credited Barbour Lathrop, of Chicago, with extensive explorations in the interests of agricultural science and with the procuring, at his own expense, of many rare and valuable seeds and plants from foreign lands, unknown in this country to-day, but in some instances of probably great value to future American agriculture. The last three world circles traced by Mr. Lathrop have been designedly for the purpose of benefiting the farmers and fruit growers of the United States, and this from a solely disinterested standpoint.

Of these, the second exploring expedition in 1898 was particularly interesting. With Mr. Fairchild as his assistant, Mr. Lathrop traveled through the West Indies and north coast of South America in search of plants and products for tropical Florida and Southern California. The results of this trip may now prove of especial value to Porto Rico. Crossing Panama, they sailed down the Pacific coast of South America, stopping in Peru, the home of the tomato, the potato, and the Lima bean, studying the wonderful plant growth in Chili, where many plants have been found suitable for California conditions. As a result of this trip, the brown Peruvian cotton was brought to the attention of our cotton growers. It is of a chocolate color, and is used in the adulteration of wool. Its unusual feature is a smooth seed, requiring only a roller gin. The Egyptian cotton is of a somewhat similar strain, and Mr. Fairchild says that the experts declare it to have Peruvian blood in it, an interesting point for the archæologist. Crossing the Andes and stopping in Argentine and Brazil, a course was finally struck for Europe, and later Egypt, where the wonderful berseem was looked into, and seed sent to Washington for distribution as a forage plant among our arid States. A long cruise followed in the Malayan Archipelago, where many strange seeds and plants were picked up and sent home.

Some important finds were made in the sub-Arctic regions of Sweden and Finland, among them the Finnish black oats, which have been found to thrive remarkably well in Alaska, and have proven the most productive and hardy above the Arctic circle. Prof. Georgeson, of the Alaska government agricultural station, says that these oats are the best grain he has tested, and will prove of great value for the interior of the Territory.

The next trip of the travelers included plant explorations of Japan, China, Ceylon and India, Sumatra, and Chaldea. At the last place, near Bagdad, are found the immense date cultures of the land of Babylon, where are produced probably three-fourths of all the dates of commerce. These date forests extend for a distance of seventy miles up and down the Tigris. Many fine date suckers were obtained and shipped to the United States, and are now growing in Arizona, and some day the great Colorado River of our Southwest, where the conditions are exactly favorable for date growing, may not only produce all the dates which America uses, but export this wholesome fruit. Dates picked, packed, and shipped by American methods will bring a higher price than the imported products, which if their history were known might not be eaten with such avidity by the fastidious. The saccharin of the date itself cures or candies the fruit, and some of the trees which have already fruited in Arizona and California have yielded very fancy and fine dates. For a long time to come, all of the dates produced in the United States will come from the Tigris and north African trees imported through the department, and their progeny will command fancy prices.

Such a mass of material had been gathered in the Orient as to necessitate another return home in 1902 to arrange for its classification and distribution; whereupon another trip was immediately started. A tour of investigation through Europe also revealed many interesting fruits and vegetables. The Sultanina seedless grape was sent in from Italy by Mr. Lathrop. The Huasco seedless raisin grape was another find. The best malting barley in the world was found growing at an old town in Moravia. Introduced under the name of Hanna barley, it has already proved of value to those regions where it has been grown, especially on the Pacific coast. It is not only earlier, but heavier yielding than other barleys; and if it is found that it can be generally substituted for the barleys now grown, its increased yield of from one to two and a half bushels per acre will add enormously to the aggregate output. A study of the hop regions of Europe by Mr. Lathrop and Mr. Fairchild revealed the fact that the American hop is far inferior in quality to the best European varieties. The importation of young plants for the purpose of producing better American hops was undertaken by the department as a result of this discovery.

In a little town near the old historical village of Kuttenberg in Moravia is cultivated what Mr. Fairchild describes as the most delicious kind of horseradish, known as the "maliner krem," which the gourmets of Vienna insist on having served with their meats. Small test patches of this variety are growing at different places in the United States.

The Jordan almond, the finest variety in the world, was found growing in Spain, and at once recognized as far superior to the almonds produced in the United States, so a supply was immediately secured and shipped. A genuine discovery of a well-known fact to many travelers, and one which both Mr. Lathrop and Mr. Fairchild think of great importance, are the hardy bamboos of Japan. These are now being tested in California and the Gulf States. Mr. Fairchild thinks they will thrive throughout the southern third of the United States. Not only are they the most ornamental plant in the world, but they are probably the most useful wood in Japan, not for making fancy furniture and knick-knacks, but for almost every use. "Tell me what you can use wood for," said Mr. Fairchild, "and I will tell you what use the Japanese can make of bamboo."

Dozens of other extremely interesting and promising plants were found, quantities secured and sent home for tests, among them a new bean from Chili; also a Grecian bean but little larger than rice, which cooks almost as quickly and is pronounced delicious. Another bean, which when properly cooked has been pronounced the most delicious vegetable ever eaten, is the broad bean of Europe. This bean can be found in the catalogues in the United States, but the trouble, Mr. Fairchild explains, is that no one here knows at what stage of ripeness to pick it nor how to cook it. A product which it is thought may result in the establishment of a new industry here is the Japanese paper plant (Mitsumata), out of which is manufactured the finest and unapproachable hand-made Japanese vellum. It appears that there is no reason why this plant will not grow over a large area of the United States. The Japanese have always been extremely reticent regarding the source of their vellum paper. A promising barley was found in Algiers, which is being tried in our arid Southwest; and new durum wheats were found in Italy, from which the finest macaroni is made, and which are believed to be superior to the macaroni wheat we have heretofore been importing from Russia for this new American industry. If mangoes, luscious as they are large, can be grown in Porto Rico, such as were found in several tropical countries, Mr. Fairchild says that the United States will be offered one of the most delicious fruits imaginable. Mangoes from Porto Rico, as well as the mangosteen, can be easily laid down in New York, Chicago, or any of the large American cities.

The number of these discoveries and introductions is so great, and such an exhaustive test is in each case made by the department before anything is recommended for introduction, that it is practically useless for farmers or fruit growers to write the department for samples of the strange and interesting things which its agricultural explorers have secured. Until any product is determined to be practicable for growth in the United States, it is not possible to secure any seeds or specimens. In fact the department has none. Those that are sent in are immediately distributed among the government experiment stations and to a few practical growers, who are especially able to properly attend to the experiments under the direction of the department. However, the possibilities of these tests are very great, and Congress would be well warranted in diverting some of the immense annual appropriation for "free seeds" into this channel of introducing for American farmers something which may prove of real and national benefit.

[Concluded from Supplement No. 1470, page 23552.]

WHALE OIL.*

By Charles H. Stevenson.

REFINING SPERM OIL AND WHALE OIL.

The rendering and care of the oil on shipboard having been described, there remains to be discussed its further treatment for commercial purposes, especially extraction of the foots and bleaching. The headquarters of the refiners of whale oils in the United States are at New Bedford, Mass., and San Francisco, Cal. Twenty years ago New Bedford monopolized the business, but large refineries have been erected at San Francisco, and at present about 20 per cent of the sperm oil and 60 per cent of the whale oil are refined at that port. The subjoined description is prepared almost wholly from information furnished by the principal refiners of New Bedford in 1901. The writer wishes especially to acknowledge, in this connection, the courtesies of Messrs. William A. Robinson & Co., and of Messrs. Frank L. Young & Kimball.

As received at the refineries, the casks of oil have been inspected and gaged by customs officers. They may have been kept in storage for months, and in some cases years, before reaching the refiner. Formerly, on the wharves at New Bedford might be seen thousands of casks filled with oil awaiting sale, being preserved from great leakage in the meantime by a covering of seaweeds; but in recent years the quantity has been much reduced, and on the occasion of the writer's last visit to New Bedford (October, 1901) not a single barrel of oil was on the wharves.

The oil is of two principal kinds, viz., sperm oil and whale oil, the former being obtained from sperm whales and the latter from all other varieties of whales and also from walrus, black-fish, sea-elephant, etc. It ranges in color from clear amber to very dark brown, depending on the variety of animal, the condition of

* From United States Fish Commission Report for 1902.

the blubber, and the success of the rendering. The quality is determined by appearance, odor, and flavor. There is some difference in the value of crude oil of the same species of whale from northern and from southern seas, the former selling for a few cents more per gallon. Crude sperm oil was formerly worth about double the value of whale oil, but in recent years the difference has been much less. Little use is made of unrefined sperm oil, but considerable of the product of whale oil is sold in a crude state to steel-workers, miners, and cordage-manufacturers.

The products from refining sperm oil are the "winter sperm," which is the first running from the crude oil after it has been granulated by refrigeration; the "spring sperm"; the "taut-pressed," and spermaceti. The refined sperm oils are not generally sold in their natural color, however, but are usually bleached by a process which leaves "sperm-oil soap" as a product. The products of whale oil, including that of walrus, black-fish, sea-elephant, etc., are the winter, spring, and summer pressings, a tallow-like substance known as whale foots, and "oil soap."

Sperm Oil.—The two varieties of oil obtained from sperm whales, viz., body oil and head matter, differ greatly in appearance. The former is of a light straw color, while the latter when first taken from the head of the whale is as clear and limpid as water, but after a short time thickens and hardens into a white mass. Each animal is supposed to yield about two-thirds body oil and one-third head matter. These are kept separate on shipboard, but when received at the refineries they are generally mixed in natural proportions and together submitted to the processes for separating the oil and spermaceti.

In the process of refining, the crude oil is drawn from the casks and heated for the purpose of driving off all the water. This is conveniently done by running it into large iron tanks of several hundred, or even thousand, gallons capacity, where it is subjected to heat by means of coils of steam-pipes running around the inside of the tanks. When heated in excess of 212 deg. F. all moisture is soon expelled, and the oil resists water; that is, water will refuse to mix with it and will "snap" when dropped into the oil. By continuing the heating from six to ten hours the crude oil is converted into a clear liquid state, all particles of fat and blubber boiling out and the impurities settling at the bottom of the tank. The steam is then shut off and, after the oil has partly cooled, it is drawn off from the top of the tank into barrels or casks with capacity of about 50 gallons each. The sediment which precipitates at the bottom is drawn off and made into soap.

In the barrels the oil is chilled. In cold weather, from December 1 to March 31, this is done by exposing the barrels and their contents to the weather; but during the balance of the year it is necessary to place them in large covered pits, where the oil is frozen by using ice and salt packed among the barrels. To avoid the expense of artificial refrigeration, it is preferable to do the refining during the winter season.

After remaining in the pit from ten to fourteen days, at a temperature of about 32 deg. F., the oil is thoroughly chilled, shrinks, and separates or granulates into little balls or grains. It is then removed from the refrigerator, shoveled from the barrels into canvas or hempen bags holding from 2 to 4 gallons each, and placed in a press, where it is subjected to a pressure of from one to two thousand pounds to the square inch. There is thus pressed out a clear, cold oil known to the refiners as "winter sperm oil," which will stand bright or will not congeal at a low temperature fixed as a standard. Formerly the standard was 32 deg. F., but at present the usual commercial test is 38 deg. F. Oil of 23 deg. F. test has been prepared, but there was no demand for it. Since the lower the temperature at which the congealed oil is pressed, the less the quantity yielded, it is not desirable to use any lower temperature than required. When producing oil of 38 deg. F. test, the amount of "winter sperm oil" yielded is about 75 per cent of the original quantity. In former times when a 32 deg. F. test was used, the "winter sperm oil" was about 67 per cent of the original bulk. This may be sold either in its natural state or bleached. It is used principally as a lubricant, and, to a less extent, as an illuminant in mines.

After the "winter sperm oil" has been pressed from the bags there remains in them a solid of a brownish color, which is again submitted to pressure at a warmer temperature, say 50 deg. to 60 deg. F., and there is produced an oil known as "spring sperm oil," which congeals at the test of 50 deg. to 60 deg. F. above noted. The quantity of "spring sperm oil" is about 9 per cent of the original quantity of crude oil.

The solid now remaining in the bags is emptied into receptacles and, after remaining for several days at a summer temperature, is dumped out in the form of solid cheese-like cakes. These are stored where the temperature is kept at about 80 deg. F., and in the course of a week or so are shaved up by revolving knives and again bagged and subjected to a pressure of about 100,000 pounds to the square inch. This yields a third grade of oil called "taut-pressed oil," which will chill at a temperature of 90 deg. to 95 deg. F. The quantity of oil of this grade is about 5 per cent of the original bulk, making a total of 89 per cent of refined oil obtained. The residue in the bags after the extraction of "taut-pressed oil" is crude spermaceti of a brown color, which will melt at a temperature of 110 deg. to 115 deg. F.

As refined at the present time, sperm oil, including both body oil and head matter, yields about 11 per cent of crude spermaceti and 89 per cent of refined oils, in the following proportions: 75 per cent of "winter sperm," 9 per cent "spring sperm," and 5 per cent "taut-pressed oil." A barrel of crude sperm oil of 31½ gallons, weighing 231 pounds, yields 25 pounds of refined spermaceti, 23.6 gallons of "winter sperm," 2.8 gallons of "spring sperm," and 1.5 gallons of "taut-pressed oil." The prices of these (January, 1902) are: Spermaceti, 23 to 24 cents per pound; winter sperm, 75 to 77 cents per gallon; spring sperm, 60 to 61 cents; taut-pressed, 50 to 53 cents, and sperm soap 3 cents per pound; a total of about $24.50 resulting from one barrel of crude oil.

Sperm oil is one of the most characteristic and valuable oils in commerce. It is very generally conceded to be the best lubricator in existence for light, rapid machinery, such as the spindles of cotton and woolen mills, its viscousness, tenacity, and high flash-point causing it to work with great uniformity and with a small amount of friction. But there are many cheap substitutes—made from petroleum principally—which though not so good, answer the purpose nearly as well; consequently the demand for sperm oil is far less than formerly, and even much of that sold as sperm contains a large admixture of hydrocarbon and other oils.

Whale Oil.—The color of whale oil depends on the "age" of the blubber, or the time that elapses between the death of the whale and the trying-out of the oil. Usually it is brown, much darker than sperm oil, with a slightly disagreeable odor. In a crude state it is used to some extent by screw-cutters, steel-temperers, cordage-manufacturers, and as an illuminant for miners' lamps, but more than half is refined in a manner similar to the treatment of sperm oil. The first boiling and freezing processes are the same as with sperm oil. When removed from the refrigerator the congealed mass is usually dumped on woolen strainers, 2 feet wide and from 10 to 20 feet in length, stretched across frames. The process of straining is employed to reduce the bulk, since much oil will pass through the woolen cloth and leave a less quantity to be pressed. The thick part remaining on the strainers is placed in bags, as in case of sperm oil, and subjected to great pressure. The first oil from the press congeals at 36 deg. to 40 deg. F. and is called "winter whale oil." The foots or stearin that remains in the bags, averaging one-tenth of the original bulk, and about the consistency of leaf lard, is usually white and clean. This may be reheated and refrigerated, and upon a second pressing yields "spring whale oil" of a higher degree test; but this is not frequently done.

The oil with the foots removed may be sold in its natural color or it may be bleached. One-eighth of the whale oil and probably half of the sperm oil is bleached by the refiners. In this process it is first placed in the refining tanks and heated. When partially cooled the water and sediment are drawn off from the bottom of the tank, and while the oil is agitated or stirred some soda ash or caustic soda is added. This so acts on the oil as to cut the gum, and the thick part settles to the bottom, leaving the oil clearer and of a lighter color. It is also accomplished by exposing the oil under a glass roof to the sunlight for a few hours, or even days, in large shallow vats or pans from 3 to 12 inches deep, each with capacity for several hundred gallons.

The refuse in the bottom of the tanks is drawn off and boiled down into oil soap, which is worth about 3 cents per pound. The first bleaching will give about 2 per cent in hard soap, the second and third each give about the same. If the oil is clear and sweet the first bleaching is sufficient. Much of the oil soap is shipped to California, Florida, and other fruit-growing sections, where it is employed as a wash for trees to protect them from the ravages of insects. It is also used to some extent in fur-dressing.

In the usual pressings, the oil of the right whale taken in high northern latitudes gives about 8 per cent of foots or stearin; if taken in the vicinity of the equator, or south of it, about 15 per cent of stearin is yielded. Humpback and finback oils yield about 12 per cent of foots; sea-elephant yields 5 or 6 per cent; menhaden from 5 to 10 per cent; and seal oil yields only 3 or 4 per cent in the customary pressings. Of course this varies according to the temperature at which the oil is pressed. Tallow regulates the price, in a measure, as the stearin is substituted to quite an extent for that article. The market price approximates 5 cents per pound. It may be refined in a manner similar to spermaceti, though it is generally sold in the crude shape, packed in barrels. The chemical constituents are mainly glycerides of stearic and palmitic acids, mixed with oil. It is used principally as a sizing for yarns, smaller quantities being used in Europe for smearing sheep after shearing. Other uses are in making soaps and in filling or stuffing leather.

The various whale oils are hard and strong, and range in specific gravity from 0.900 to 0.927 at 59 deg. F. Oil of the right whale has specific gravity of 0.925 to 0.927 at 59 deg. F. Oil from the humpback and likewise from the sulphur-bottom whale is somewhat lighter in weight, the specific gravity varying between 0.915 and 0.920 at 59 deg. F. According to Brannt, the composition of right whale oil is carbon 76.85 per cent, hydrogen 11.80 per cent, and oxygen 11.35 per cent; while that of humpback and sulphur-bottom whales is carbon 77.05 per cent, hydrogen 12.05 per cent, and oxygen 10.90 per cent. Refined whale oil is extensively used in machine shops to reduce friction, particularly in cutting bolts and screws. It is also used as stuffing in leather-dressing, especially in the manufacture of chamois leather.

The following summary, compiled from the trade journals, shows the range of prices per gallon for crude sperm oil and for whale oil during a series of years ending in 1901:

Statement of the maximum and minimum prices per gallon of sperm and of whale oil each year from 1868 to 1902, inclusive.

Year.	Sperm oil per gallon.		Whale oil per gallon.	
1868	$1.75 to	$2.00	$0.64 to	$1.13
1869	1.59	1.93	.84	1.13
1870	1.22	1.55	.63	.75
1871	1.22	1.57	.54	.84
1872	1.35	1.63	.62	.73
1873	1.40	1.55	.52	.68
1874	1.50	1.66	.57	.63
1875	1.48	1.84	.62	.70
1876	1.27	1.62	.55	.70
1877	1.03	1.40	.50	.70
1878	.81	1.05	.35	.52
1879	.71	1.00	.35	.57
1880	.80	1.08	.45	.57
1881	.87	1.05	.50	.59
1882	1.05	1.15	.57	.60
1883	1.08	1.15	.56	.60
1884	.87	1.05	.55	.63
1885	.85	1.00	.42	.55
1886	.67	.85	.36	.48
1887	.57	.65	.35	.36
1888	.55	.62	.37	.40
1889	.62	.68	.40	.42
1890	.58	.65	.42	.50
1891	.63	.68	.50	.54
1892	.63	.65	.50	.53
1893	.62	.90	.40	.48
1894	.56	.62	.38	.43
1895	.50	.56	.36	.40
1896	.35	.45	.30	.35
1897	.36	.49	.32	.38
1898	.38	.57	.31	.39
1899	.40	.61	.32	.40
1900	.45	.60	.33	.37
1901	.55	.68	.34	.38
1902	.62	.70	.34	.38

In the early years of the whale fishery nearly all the sperm oil produced in the United States fisheries was exported in a crude condition, and during the period of greatest prosperity in the fishery about one-half was exported, but at present the exports in a crude state are very small. For the first time in a hundred years none whatever was exported in 1901. Most of it is refined at New Bedford, and some of the refined oil and a large percentage of the spermaceti are exported. Of the whale oil the greater part is consumed in this country.

The annual product of sperm and whale oils, quantities exported and quantities consumed in this country, are shown in the following:

Table showing, in barrels of 31½ gallons each, the production of sperm and whale oils by the whaling fleet of the United States, the export to foreign countries, and the home consumption from 1860 to 1901.

[Compiled from the Whaleman's Shipping List.]

Year.	Sperm oil. Production.	Sperm oil. Export.	Sperm oil. Home consumption.	Whale oil. Production.	Whale oil. Export.	Whale oil. Home consumption.
	Bbls.	Bbls.	Bbls.	Bbls.	Bbls.	Bbls.
1860	73,708	32,792	38,507	140,005	13,007	143,009
1861	68,932	37,547	31,091	133,717	49,969	105,839
1862	55,641	27,976	27,759	100,478	68,583	67,254
1863	65,055	18,366	32,727	62,974	11,297	65,352
1864	64,372	45,000	30,190	71,863	12,000	62,528
1865	33,242	20,158	27,666	76,238	1,640	64,107
1866	36,663	10,630	19,133	74,302	618	69,534
1867	43,433	25,147	22,968	89,289	18,253	58,836
1868	47,174	18,916	23,258	65,575	9,885	72,390
1869	47,936	18,645	17,239	85,011	3,842	56,256
1870	55,183	22,773	28,812	72,691	9,872	68,452
1871	41,534	22,156	33,528	75,152	18,141	63,011
1872	45,201	24,344	24,052	31,075	1,528	42,852
1873	42,053	16,238	24,190	40,014	2,153	33,881
1874	32,203	18,675	21,768	37,782	3,300	44,357
1875	42,617	22,802	18,453	34,594	5,424	31,860
1876	39,811	23,600	14,473	33,010	10,300	22,620
1877	41,119	18,047	31,737	27,191	6,390	20,501
1878	43,508	32,769	11,124	33,778	14,371	12,557
1879	41,308	11,843	23,315	23,334	7,374	24,885
1880	37,614	12,283	17,750	34,776	4,395	23,856
1881	30,600	16,600	25,275	31,650	6,450	32,000
1882	29,844	13,006	13,053	23,371	4,421	21,425
1883	24,595	13,996	17,324	24,170	4,543	19,052
1884	22,009	5,143	15,481	24,670	2,343	23,777
1885	24,203	7,554	18,279	41,586	5,384	50,529
1886	23,312	3,118	15,170	27,249	18,253	9,176
1887	18,873	4,955	14,953	34,171	8,205	34,786
1888	16,265	1,345	21,410	17,185	8,578	7,747
1889	18,727	5,823	13,339	14,247	440	12,667
1890	14,480	2,000	11,015	17,565	4,366	14,549
1891	13,015	3,218	14,412	14,837	608	13,864
1892	12,944	1,787	12,757	13,382	291	12,746
1893	15,253	1,165	11,088	8,110	1,164	6,721
1894	16,333	1,720	7,764	9,720	276	8,379
1895	16,585	1,225	15,949	4,009	825	4,534
1896	15,124	215	20,419	4,800	500	5,050
1897	15,070	280	18,020	3,600	422	3,178
1898	12,520	1,952	11,848	5,295	675	4,450
1899	11,903	550	13,085	3,827	..	3,997
1900	18,525	1,100	17,973	5,510	500	3,410
1901	14,910	....	17,980	2,930		4,530
1902	21,970	470	*18,250	4,725	400	†4,325

* On hand January 1, 1903, 3,600 barrels sperm oil. † There was no whale oil on hand January 1, 1903.

THE OTTUMWA BOX CAR LOADER.

The accompanying illustration showing the Ottumwa box car loader is from a photograph of the machine located at a washery for loading coal from the different pockets. This loader is necessarily made portable, so as to be run the full length of the building, and to load from all the pockets.

The Ottumwa loader is built both stationary and portable, the stationary pattern being located on a permanent stone or brick foundation, and the portable one being built on a car opposite the loading chutes, and usually provided with a boiler, water tank, and everything complete for furnishing its own power, or else with an electric motor. The stationary loader is generally used at coal mines, and the portable loader is particularly designed for use at docks.

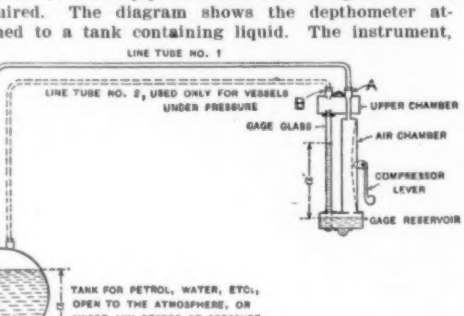
The method of loading the coal is interesting. The machine is designed to carry and push the coal back carefully to the ends of the car, and avoid all rough handling. The main frame of the machine is supported from the car or the stone foundation, as the case may be, and outside the car to be loaded. The frame is projected inside the car. On the forward end of this main frame is a hopper thirteen feet long, having about one ton capacity. This hopper works back and forth across the main frame of the machine alternately toward each end of the car. The chute from the bins, or from the mines, extends into the car just far enough to deliver the coal into this hopper. When the hopper is filled, as it passes along past this chute, it is extended to its extreme length toward one end of the car, and is then held stationary, while a movable end gate or pusher travels through the length of this hopper, and pushes the coal out to the ends of the car. The hopper is then automatically released, and travels back past the chute to the opposite end of the car. The process is then repeated, that is, the coal is pushed out. This hopper will travel easily from four to six trips per minute, or when it is in actual operation, will load easily from four to five tons of coal per minute. At the same time, this is such a slow speed that there is practically no breakage of the coal resulting from the handling of it in this manner. Counting all the delays occurring from numerous causes around the mine, and those due to the changing of cars, the capacity of the loader will be about one hundred and fifty tons per hour.

The loading of coal in box-cars is becoming much more general than it was a few years ago, and it is fast becoming necessary to have every mine equipped with proper machinery for loading box-cars. The old method of hand loading is very expensive from a labor standpoint, and a still more serious item is the delay usually caused by loading box-cars, by reason of the men being unable to take care of the coal as fast as it is dumped. The number of men that can work inside a box-car, shoveling the coal back, is limited to four, and four men working all day can handle only from two hundred and fifty to three hundred tons per day. By working relays of men, as is often done, allowing each set of workmen to rest while loading alternate cars, the tonnage can be increased to about six hundred.

The loader is made almost exclusively of steel parts, and is very strong throughout. It is manufactured in Ottumwa, Ia., by the Ottumwa Box Car Loader Company.

THE DEPTHOMETER: A DEVICE FOR MEASURING THE DEPTH OF LIQUIDS IN TANKS, ETC.

UNITED STATES CONSUL WATERMAN, at Dublin, Ireland, describes a depthometer invented by Mr. Leonard Murphy and manufactured by Daniel Miller & Co., Dublin. It is an instrument designed to show the depth of liquids either in open vessels—such as water tanks, vats, ships' holds, wells, etc.—or of liquids inclosed in vessels under any degree of pressure, as in the case of fuel tanks in some motor cars and other reservoirs of this kind. It may be placed at a distance from, and at any level relative to the tanks—above, below, or on a level with them. Any number of tanks may be connected to one depthometer and the depth of each ascertained by indicating one at a time. The reading of the indicating column of the depthometer is absolute, marking to a fraction of an inch the depth of the liquid being indicated. The reading can, of course, be reduced proportionately by using mercury or other heavy liquid for the indicating column. No floats or moving parts are used in the vessels being indicated, a fixed pipe of small bore being all that is required. The diagram shows the depthometer attached to a tank containing liquid. The instrument,

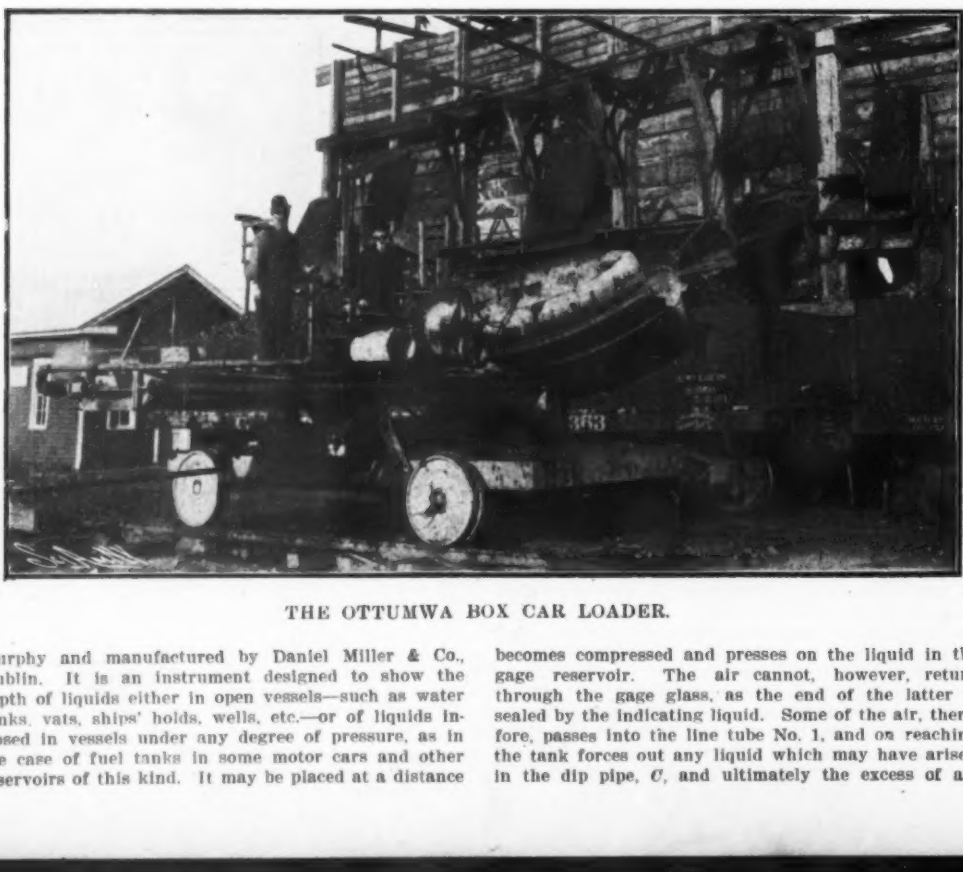


DEVICE FOR MEASURING DEPTH OF LIQUID IN A TANK.

shown in section, is placed somewhat above the tank and registers the exact depth of liquid in the tank by means of the column of liquid seen in the gage glass. When wishing to ascertain the depth of liquid in the vessel connected, it is merely necessary to raise the lever marked "compressor lever" and bring it back again to its starting point. On doing this the exact depth being measured will be shown by the column in the gage glass of the depthometer.

The parts of the depthometer shown in the diagram are as follows: Two chambers, fixed one above the other, are connected by a gage glass tube, open at both ends, which reaches almost to the bottom of the lower chamber and only just enters the upper chamber from beneath. The top one is called the "upper chamber" and the lower chamber is called the "gage reservoir." The latter has attached to its top a flexible "air chamber" capable of being enlarged or reduced in volume by the compressor lever in the diagram. To the upper part of the air chamber a short tube and coupling, *A*, is attached, from which the line tube, No. 1, can be carried to the distant vessel, terminating in a dip pipe, *C*. If the vessel be under pressure, a second line tube, No. 2, is necessary and is laid beside the first tube, reaching from the top of the tank to the upper chamber, coupling at *B*, as shown in dotted lines on the diagram. This pipe is, however, not used if the vessel be open to the atmosphere, and in that case coupling *B* is left open to the air. The gage reservoir is next almost filled with the indicating fluid (gasoline, water, etc.), and when at rest the liquid should just appear at the base of the visible portion of the gage glass. The instrument is then ready for use.

The method of working is as follows: Raise the compressor lever to its highest point, thus causing the air chamber to expand and take in a supply of air; the latter enters at coupling *B*, passes through the upper chamber, down the gage glass, through the liquid in the gage reservoir, and finally reaches the air chamber. On depressing the lever the air in this chamber becomes compressed and presses on the liquid in the gage reservoir. The air cannot, however, return through the gage glass, as the end of the latter is sealed by the indicating liquid. Some of the air, therefore, passes into the line tube No. 1, and on reaching the tank forces out any liquid which may have arisen in the dip pipe, *C*, and ultimately the excess of air escapes from the open end of the dip pipe into the liquid in the tank. During this operation the liquid column in the gage glass of the depthometer will be seen to rise gradually to a certain point and then stand. The column ceases to rise further the moment the air commences to escape at the open end of the dip pipe in the tank, and the column thus shown will be equal in height to the depth of the liquid in the tank, as it will be seen that the air, having completely filled the line tube, has created an exact balance between the column of liquid in the tank and the indicating column of the depthometer.—Consular Report.



THE OTTUMWA BOX CAR LOADER.

STEAM REGENERATION: ITS HISTORY.

By H. J. BARRON.

MR. BALFOUR, the present Prime Minister of Great Britain, stated in an addresss some years ago before Glasgow University, that he marveled that the nineteenth century science had done nothing to save the coal fields of the world; that he understood that of every pound of coal burned, but one-tenth of it was used in effective work, and nine-tenths of it wasted in the process. Alas for the layman! Alas for us all when we go outside of our own little field of effort!

Sir William Siemens, who will probably be remembered when all nineteenth century statesmen are forgotten, about 1850 produced his regenerative steam engine, spent possibly £50,000 in experiments, and time and genius worth possibly £50,000,000 to the British nation, or which would have been worth that much if he had been encouraged in this part of his work. At the same time Spence, of Nottingham, was working on a regenerative engine.

As Siemens' engine was exhibited at the first Paris Exposition, I believe, it is more than likely that French engineers were also working in this field, but I know nothing of their work, nor do I know what Tredgold, Trevithick, Woolfe, and the engineers contemporaneous with Boulton and Watt thought and did in this direction. How few of us realize what the modern steam engine owes to the strong personality of Boulton, who risked his immense fortune and his business honor in backing up the visionary Watt, the noblest visionary in the history of mechanical progress.

Sir William Siemens' biographer states that steam engine progress will yet culminate on the lines followed by Siemens. Stirling, a contemporary of Siemens, produced the regenerative air engine. These men had no proper conception of energetics and the value of the heat unit—that was developed later; but they were familiar with Sadi Carnot's dictum, that all heat not turned into work shall be returned to the reservoir, and the mathematical mind of that French physicist of the latter eighteenth century (the eighteenth century ended in 1830) had defined for all time a perfect heat engine. The work of the middle nineteenth century passed away almost without record. The mechanical periodicals of the time and the great steam engineers passed it over as unworthy of notice.

About 1870 a young civil engineer named Merchant, in London, built the Merchant regenerative engine, exhibited it, and puts lots of them in use. I am told that he invested in his works £130,000 of his own and his father's money. When this was all gone, he went to his grandfather, a banker, and borrowed all he could spare, £70,000 additional, making the investment equal to nearly a million dollars; then he failed, and died when a little over thirty years old, a martyr, and yet Mr. Balfour thinks scientific men have done nothing to solve the problem of steam engine efficiency. Contemporaneously with Merchant, one Bouregard, a Frenchman, was working in France and England on the problem, and also took out American patents. Merchant worked on a theory of graded compressions, or an accumulated series of compressions, while Bouregard went at the problem in what, for want of a better term, I shall call a chemical process, i. e., by mixing low-temperature fluid with superheated fluid. A little later, Gerner, an American, or as I should judge, a German-American, patented an injector system of forcing the exhaust back into the boiler. He was less mechanical and less scientific than the previous workers in this field.

Those who are more or less familiar with steam engineering literature of forty years ago, will remember how the tone of it was that all attention had been given to the engine, and that the boiler was neglected; but the real facts were that relatively the boiler was a fairly efficient machine, while the engine was an exceedingly wasteful one.

The problem forced on steam engine specialists today is to meet the competition of the gas engine, which in the last few years has increased its efficiency to fully 25 per cent; this demands an increase in steam engine efficiency, which must come in and from the engine, and not from the boiler, as the latter has been advanced by boiler engineers to practically an ideal efficiency.

Should the work of Siemens, Merchant, their contemporaries, and successors culminate and prove ultimately practicable, we need not anticipate witnessing the displacement of the steam engine by any other form of heat motor.

When Rankine, Clausius, and Thompson were developing the dynamic theory of heat as a matter of physical and engineering theory, Sir William Siemens, in the light of the new ideas, made a bold attempt to improve the efficiency of the steam engine as a converter of heat into mechanical work. Taking up the

regenerator, a device invented by Stirling twenty years before, the importance of which had meanwhile been ignored, he applied it to the steam engine in the form of a regenerative condenser with some success. This was in 1847, and in 1855 engines constructed on Siemens' plan were worked at the Paris Exposition. Later, he made many attempts to apply the regenerator to internal combustion gas engines, but in neither direction was his work fruitful; but that direction is the only one in which improvement is possible.

In the late Prof. Thurston's paper "The Promise and Potency of High Pressure Steam," of December, 1896, read before the American Society of Mechanical Engineers, in his first chapter on page 10 he states: "The heat supply occurs in a manner quite different in the case of the Carnot cycle from that characterizing the other standards of heat and steam distribution. The communication of heat to the fluid takes place by transformation of dynamic into thermal energy in the midst in the process of final adiabatic compression. As is sometimes said, the cycle is characterized by possessing a dynamic heater." In the last pages of the same paper he says: "Change of cycle is the next most promising direction of gain apparently; by the adoption of the Carnot cycle, it is possible to increase the efficiency of the engine about 20 per cent above that of the common approximate Rankine form of cycle. This may not be at all impossible, and a number of methods of obtaining this result may yet be found." Further on he says: "Beyond these lies at least one direction of further gain by reduction of wastes, and one of advance by increase of the proportion of heat transformed thermodynamically."

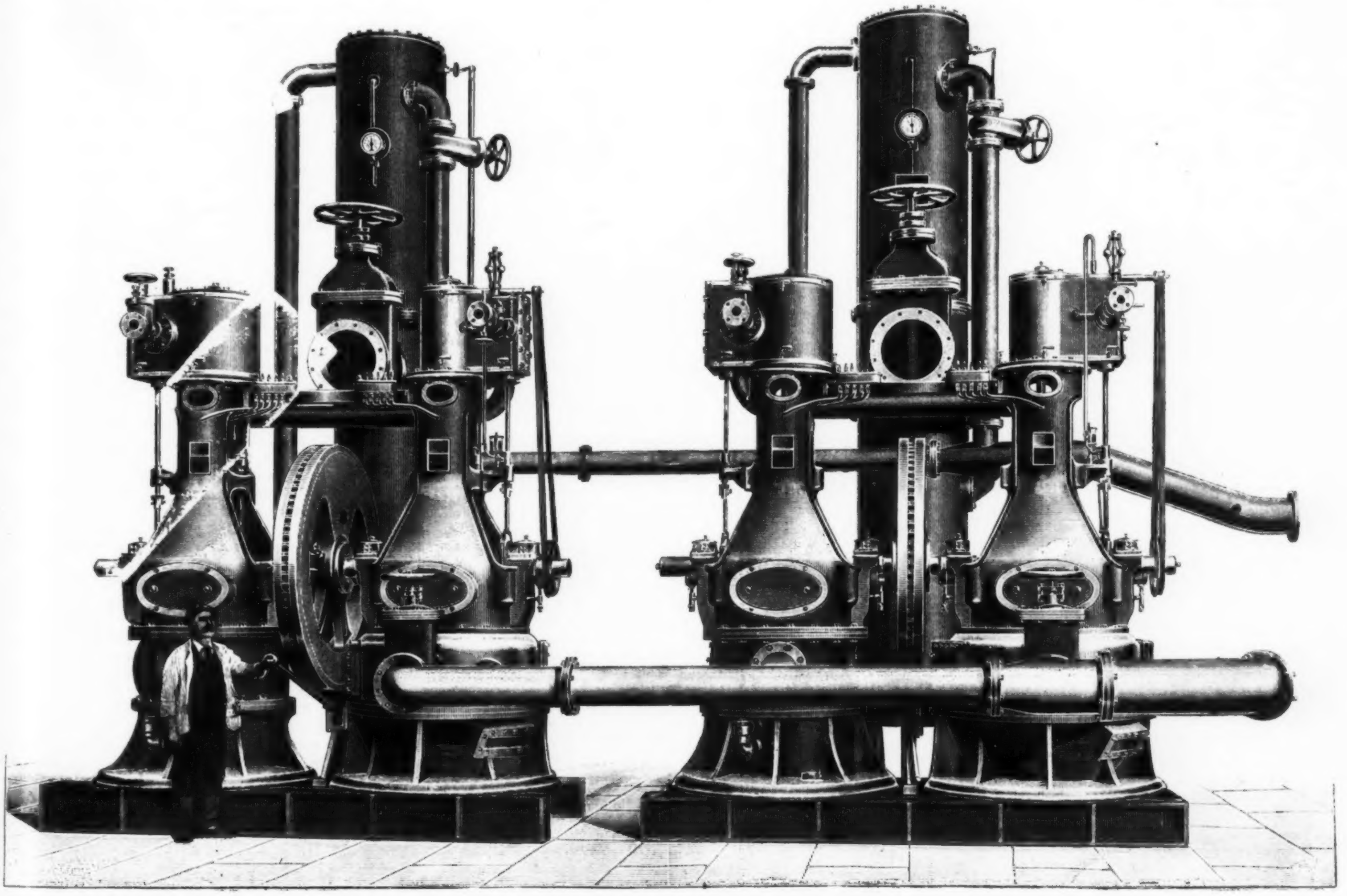
"The former resource is the now familiar scheme of finding a non-conducting cylinder wall; the other is the employment of steam gas, and probably in some such manner as was attempted by Sir William Siemens. The first of the expedients will convert the engine into a purely thermodynamic machine; the latter will raise its thermodynamic efficiency to the Carnot limit."

Prof. Thurston in these statements foreshadows what I believe is the practical perfection of the engine.

INDEPENDENT CONDENSING PLANT.

WE illustrate a very fine example of an independent condensing plant designed and constructed by Messrs. Cole, Marchent & Morley, Limited, Bradford. As the plant is to work in the tropics, special proportions have been adopted suitable to the high temperature of the condensing water. It will be gathered from our engravings that the installation is of unusual size and power. It takes steam from several engines exhausting through a main common to them all. As the load varies, two entirely independent condensers with their pumps are provided. On the peak both condensers are used, while one can deal with light loads or take the full load with lower vacuum when the other set is stopped for overhauling.

The condensers are of the counter current jet type—that is to say, the steam and air inside the condenser have a tendency to pass in the opposite direction to the water, and the internal arrangement of the condenser is such as to allow for this. To take full advantage of this system it is desirable to have the air and water pumps separate. Each unit has two flywheel type pumps of massive construction, coupled together and operated by compound steam cylinders. One pump, dealing solely with the air, is of the Edwards type, taking its suction from the top of the condenser. The other is a double-acting circulating pump, specially constructed for the duty and for high-speed running; it takes the water from the condenser and delivers it to the top of the cooling tower. The complete installation includes a fan draft cooling tower, two sets of condensing plant, piping, fans, and motors, and would deal with 60,000 pounds of steam per hour. These particulars give an idea of the general design, and there are a number of carefully worked-out details which will be noticed in the illustrations.—Engineer.



INDEPENDENT CONDENSING PLANT.

THE SANDING-UP OF TIDAL HARBORS.

AT the ordinary meeting of the Institution of Civil Engineers on Tuesday, January 26, 1904, Sir Alexander Binnie, vice-president, in the chair, the paper read was "The Sanding-Up of Tidal Harbors," by A. E. Carey, M.Inst.C.E. The following is an abstract of the paper:

The author first deals with the effect of the disturbance of the balance of the littoral forces on a tidal foreshore by solid works, and of the principles which regulate the construction of groines. The object of the paper is to indicate the effects of sanding-up in harbors situated (1) where no river debouches, and (2) at the mouths of rivers or estuaries. The author refers to the historical side of the question as detailed in Minard's "Ports de Mer," to show the futility of merely prolonging entrance piers into deeper water. He points out that the entrance of the harbor of Santa Ana, Curacao, although an ideal natural harbor, was permanently narrowed by a hurricane in 1877.

Reference is next made to the expedient of sluicing basins, as to which particulars are given of that under construction at Ostend, and an opinion expressed generally adverse to the adoption of the system. The author then describes the measures taken to dredge and maintain the channels to the port of Ostend. Of three channels, one is now abandoned and the other two are kept clear by the annual dredging of 950,000 cubic meters. Similarly the port of Boulogne requires the annual dredging of 535,000 cubic meters. He considers that dredging is the only satisfactory expedient for conserving working depths at the mouths of sand-threatened harbors. He quotes Littlehampton as an instance of a permanent harbor at a river mouth, but points out that the entrance is almost dry at low water. Stress is laid on the character and coarseness of sand as an important factor in its travel, and the method of travel along a sea bottom is described. By means of diagrams the action of the flood and ebb travel on coast lines having standard contours, and various arrangements of breakwaters and piers, is demonstrated, showing in each case the position of the shoaling which results. By a further series of diagrams the author demonstrates the contingent effect of a prevailing wind. Viaduct piers cause no disturbance of the coastal *régime*.

As an actual instance of the extinction of a harbor by sand, the author gives particulars of the obliteration of Ceará Harbor, Brazil, a work which occupied ten years, and cost over £400,000. He then gives the various stages of the harbor of Madras, details the original studies of the late Mr. W. Parkes, and the changes in the contour of the coast which resulted from the first two years' working. Attention is called to the fact that a progressive shoaling of the entire area of the harbor up to the original 7½-fathom line has resulted, and the substance of the opinion of the late Sir Andrew Clarke, in his report to the Indian government as to the position of affairs in 1879, and his recommendations at that date, is given. The Commission of 1882 and their recommendations, and those of the mixed commission appointed by the Indian government in 1883, are referred to. The author quotes their opinion that unless the opening of the harbor as designed were closed, and a new opening to the northeast substituted, the harbor would prove valueless as a shelter for shipping.

Reference is made, incidentally, to the sanding-up of the harbor of St. Catherine's, Jersey, a work on which £200,000 had been expended, and some details are given of the early history of the Royal harbor of Ramsgate, with the opinions of Smeaton and Rennie.

The paper then deals with the question of harbor construction on the west coast of Denmark. The problem on the east coast has been the impediment due to ice, but this is now disposed of by the use of ice breakers. On the west coast the only harbor is that of Esbjerg, and, with this exception, fishing boats have no shelter except the mouth of the Limfjord. At Hirtshals a large government harbor was projected at a cost of £550,000, and the works were started in 1879. The work is now sanded-up and abandoned, except that the pier has since been prolonged. The author subsequently advocated the utilization of the Ringkjöbingfjord, and submitted plans of an isolated harbor connected by viaducts with the shore at Sandnaæshage, a favorable spot owing to the depth of water there, and the protection of an outlying reef. A fishery association has been actively at work, and the government has recently published the report of the Royal Commission on the subject of harbor accommodation.

The government has now determined on the construction of a small harbor at Skagen, and of two isolated moles, respectively at Hanstholm and Vorupör.

The author concludes that in view of the precarious nature of tidal harbor work, and the instances in which success has been only partial, a departure from established practice is called for. Harbors of refuge have a limited range of utility, unless in land-locked positions.

LESSONS OF THE BALTIMORE FIRE.*

By F. W. FITZPATRICK.

TEN years ago there swept over a portion of Minnesota a combination of forest fire and cyclone that resulted in the wiping out of several thriving villages and an appalling loss of life, paralleled only by that of the Iroquois Theatre holocaust. That was the "Hinkley fire." I was in the relief party that went to the villages' succor, and never shall I forget that scene of utter desolation that unfolded itself before us that night. The heat had been so intense, and the gale so fierce a one, that the effect on the buildings and trees and all about was as if Hades itself had been let loose. Here and there were a few lonesome chimneys left standing; all else was totally consumed. The ground was charred and hardened into an almost pavement-like surface, and comparatively clean, and there was not a vestige of a tree trunk or charred building timber to be found; absolute and complete combustion, annihilation. My first impression of the Baltimore fire brought back that other scene to me. Fire had made almost as clean a sweep in that city, leaving here and there but the tall fireproof "skyscrapers" that, at a distance—where I first saw the ruins—reminded me much of the sentinel-like chimneys at Hinkley.

Of course, I have the utmost sympathy for the business men there who have suffered such terrible losses, and in what follows I have no intention of being heartless, but will discuss the case as does a doctor in a clinic discuss the "subject" upon whom he is operating, in a few words, and without dramatic or sentimental embellishments.

Never before have our theories of fireproof construction received so severe a test; and that those skyscrapers are still standing, and that their structural members that were properly protected are intact, is all the vindication the most enthusiastic of us supporters of tile fireproofing theories could hope for.

Something like 150 acres of territory is gutted.

I was able to note the intensity of the heat as indicated by its action on the metals and brick and stone; and while the wind evidently played some peculiar pranks and made strange twistings, the terrible drafts created by the fire itself performed some wonderfully acrobatic feats, so to speak, in twisting lines vertically as well as horizontally. In places it would seem as if the blast had passed over three and four-storied buildings to attack the six and seven-storied ones most fiercely, while leaving the former to burn more slowly, and sometimes from the top down. Three or four buildings escaped in this manner from absolute destruction; one, the Safe Deposit Company building, a two-story well-built affair, went scot free. The brickwork and the iron shutters showed really but very little of the effects of the terrific heat that must have been all about it. Some actions of that fire baffle scientific explanation. In the very case of this Deposit Company building, I can understand how the fire could have swept over it so quickly; and there being nothing about its exterior that would readily ignite, that it should escape; but some distance away stands the old United States Stores building, across the street from the new Custom House. On every side of this building its neighbors have been completely gutted, while it stands to all appearances absolutely intact. The glass in the windows is not broken, and the window frames are but blistered, while the shutters inside the closed windows are charred and scorched. Could the heat simply have been intense enough to scorch this woodwork inside, through the glass, but, unaccompanied by flames, and being influenced by counter currents of air, it left the exterior unmarred? The building suffered some in the upper story by reason of the breaking of the skylights, and fire getting in that way. Then here and there in the streets stands a wooden telephone or telegraph pole comparatively untouched, and near it an iron one twisted into all sorts of shapes.

The combustion in the buildings was complete and most searching. Usually after a fire there will be charred bits of floor joists still sticking to the walls, and masses of closely packed goods or papers on the ground, their very density preventing their combustion. But not so here. In most of the buildings burned, particularly along the lines of the most intense fire, there is not a vestige of anything but brick and iron left. One would think that the draft had drawn whatever little residue there might have been up, and scattered it about in cinders and dust. Charred papers were found miles off, and whole sheets of tin were carried blocks away. Indeed, the suction or draft created was so great that many skylights and iron roofs appeared to have been at first lifted before collapsing. Some of the skylight glass appears to have been broken outward, too, and before fire could have had effect upon it from within. In some buildings the glass from the windows is mainly within them, and in others it is on the outside and well away from them, again showing that the suction of air along those streets, toward the vortex of the fire, must have been something tremendous. Then in some buildings there is very little glass to be found; it seems to have disappeared; while about others I found stalactite formations of fused glass, which indicated the terrific heat there must have been generated.

At one building, on the sidewalk there had been a bulletin board with a sheet of the latest news pasted upon it. This was but a trifle scorched around the edges. Nothing was left of the building but a few little stubs of the walls, but this bulletin board was at the corner of intersecting streets. A cross draft of cold air may have protected it, or may there not have been created an almost absolute vacuum at certain points—this for instance?

On another building, where iron and glass and stone were either twisted or fused out of all recognizable shape, a small glass sign stands undamaged with the gilded letters as bright as new!

At the fiercest of the fire were centered most of the important commercial houses. The fire fed on the factories and manufacturing plants below that point, and there gaining tremendous headway and intensity, swept this commercial district virtually out of existence. "Slow-burning," "mill-constructed," and all kinds of buildings, good and bad, went by the board. The fire seemingly tackled them from the top first, in a quick, blast-like stroke, and then what might be called a secondary fire worked horizontally along, and burned from the ground up to the point apparently first attacked by the fiercer flames. As the photographs will show, a few stalagmites, as it were, of walls and piers alone mark the site of these buildings—and only the "skyscrapers" stand in anything like structural entity, splendid monuments to our progress in the science of building.

The Continental Trust building, a fifteen-story structure, one of Baltimore's latest and best buildings, was attacked a little more than half way up its height. You can easily follow the work of the fire in these tall buildings. The most intense blast struck it about the tenth floor. I found typewriters and other metallic materials in that story absolutely fused into a molten mass, which means at least 2,800 deg. From that point up the flames were evidently less intense. Similar blasts to the first apparently struck this building subsequently, and on the other side from that first attack, but they were undoubtedly of slightly less intensity. Then the fire ate away from the second story upward more slowly, and then downward. Of course, window frames and glass, and the doors, and the finish, even the floor strips in the concrete, and all the contents of this and the other fireproof buildings, were destroyed. Some of the newspapers in their excitement stated that these buildings burnt as quickly and as completely as the wooden ones, and people, the unthinking ones, generally decry against the "so-called fireproof construction," as they call it, because they have discovered by this fire that they were wrong in their ideas that a fireproof building guaranteed immunity to even highly inflammable materials used in its decoration or stored within it. To say that the structures actually burned is, of course, foolish and manifestly incorrect, even to the most ignorant, because they are still standing, and many of them in an easily repairable condition. Take this Continental Trust, for instance; all the structural steel was incased in tile, and not a bit of it is warped or out of level. The exposed metal portions are twisted into all kinds of fantastic shapes, but the structure itself, the frame, is intact. The structural conditions of all these skyscraping buildings that were built at all within the general scheme of our theories of fireproofing stood the awful test remarkably well. The Equitable building, which is, I imagine, an old building, and one in which, though tile was used, its application was not made along scientific lines, makes a worse showing than any of the others. The soffits of its beams were exposed, the tile arches were segmental, the haunches were not concreted, evidently to save money, and on top of the beams was a heavy two-inch plank floor covered with a finished dressed flooring. But a portion of the webs of the beams being protected, the heat has twisted and curved these beams all out of shape, and necessarily distorted the columns, so that the building will undoubtedly have to be entirely rebuilt. The structures of the Calvert building, the Herald, the Union Trust, the Maryland Trust, are in fair shape to be repaired as far as the structures go, for the steelwork was fully protected by the tile fireproofing.

These skyscrapers were built to contend with ordinary conditions; for instance, if the fire had originated in any of them, it could not have gotten beyond control, and no one ever anticipated that they would be subject to any such test from without. Even if such a possibility had been thought of, I venture to state that no one in Baltimore would have been willing to pay the increased cost that would have been entailed had these buildings been erected to withstand any such terrific heat and flame. And there are few places in the country where skyscrapers could be subjected to any such test. Those in New York are surrounded by a better class of buildings than generally obtained in Baltimore. So are those in Chicago. The Washington Post very aptly puts it that a "fireproof building is one that is fireproof itself and is surrounded by fireproof buildings." That, I grant, would be an ideal condition, one that I have long prayed for and preached for, but yet that definition of a fireproof structure is not essentially correct. Such another conflagration is possible in a city like Boston, or San Francisco, or New Orleans, where you find great office buildings rising from among shanties and the most inflammable of structures, and vast areas of these all about.

In repairing these buildings in Baltimore and in building new ones of their class in this burnt district, no greater precautions need be taken, as far as structure is concerned, than we find in the best of the old ones, say the Continental Trust, for instance, because a better general class of buildings than the old wooden ones will be insisted upon by the authorities, presumably, and in that case no such conflagration could again be possible in that district.

The general condition of the tile is good. Some are of course cracked, but in the floors there is no indication of the disintegration of the materials. In some places the bottom web of the floor arches has been knocked off. It is hard to say what caused this expansion—water, perhaps; but one case that worried me a good deal was the absence of bottom webs on the floor arches in the vestibule of the Continental building. I was considerably relieved when told by one of the officers of the building that the marble men in erecting their work had knocked off all these webs for the purpose of facilitating the fastening of the marble! The superintendent who allowed anything of that kind to happen deserves at least castigation, but I was pleased, nevertheless, to find that this was no fire effect.

I have preached hard and earnestly and long against granite being used, or stone for that matter, anywhere fire can get at it. The granite and stone in all the buildings, skyscrapers as well as the others, is utterly destroyed. Possibly it may be recut in places, but the shaling and splintering generally puts it beyond redemption. The brickwork stood remarkably well, and is simply another proof of our old theory that any material to successfully withstand fire must have gone through as severe heat in its manufacture as it will ever be exposed to afterward.

The decorative terra cotta here and there has been broken off, but on the whole it came out of the fray with flying colors. The less glazing there is to terra cotta, however, the better. The terra cotta people should make their facework heavier and thicken their internal angles, so as to overcome the natural weakness of the material at its angular connections with the face and they should encourage the use of porous non-glazed surfaces.

Some people say that this fire proves that an *absolutely* fireproof building is virtually an impossibility, or one that under such stress would afford protection to its contents. It is only the unthinking who would make any such statement. The people who built the structures we have under discussion, the Baltimore skyscrapers, used fireproof methods only about their structural parts. In the finish and all else in these buildings there was absolutely no difference between them and the firetraps that stood all about them, and which have now disappeared from the face of the earth. In so far as that fireproofing went it has been most eminently successful, and this terrible fire demonstrates its value more forcefully and potently than anything that has happened in the past twenty years.

Think of the test the steelwork was subjected to! Imagine dropping a lot of closely bound and connected metal, one very susceptible to variations in temperature, into a furnace where different parts of that metal would be subject at the same time to heats of 98 deg., 3,000 deg., and 400 deg., and remember that that metal was incased in sometimes not over two inches of tile, and that its parts were not warped, disjointed, or otherwise damaged by that terrific heat test. At some one time those tall buildings underwent about those variations of temperature. Realizing this, and having those buildings standing before us in splendid proof of their stability, how can any one making claim to the possession of even ordinary intelligence state that "fireproofing" is not fireproof?

The great fire of Chicago in 1871 had for effect that, the country over, frame buildings were barred within certain limits. This great fire of Baltimore is another step in the popular education, and will result in people doing more thorough fireproofing in their structures, and using less damageable materials in their exterior and interior decorations. But this education is slow—awfully, pitifully slow—and enormously costly. It will take another such terrible experience to thoroughly impress the people with the fact that we so-called cranks on construction *are* right, and not making unreasonable demands in the line of improved methods of building. We realize and appreciate the possibility of such things happening, but people call us "croakers" until the things we foretold would happen do happen; then they come to us and tell us how clever we are, and ask our advice as to how *they* should build, and then they go off and erect the flimsiest of things the too complaisant laws will allow; because, forsooth, our way costs more money than they care to expend. Judging from my mail these days, both architects and laymen have experienced a change of heart, and are anxiously and insistently desirous of advice how to build *well*, rather than cheaply. But the desire will only last a few weeks, or months, perhaps. City laws *compelling* people to build well are our only absolute safeguard—good laws and laws well enforced by competent and zealous officers are the solution of the building problem.

Some time ago, in these same columns and in the daily press, I made a statement that may be worth repeating to-day. In the light of what has happened within the week, the quotation may not be without point: "By years of persistent digging at the same subject we cranks on fireproofing have succeeded in

* From Fireproof.

getting people to build a large number of buildings whose structures are absolutely impervious to fire. [Baltimore must have proved that beyond a shadow of a doubt and to the most skeptically inclined.] . . . It has been hard work, and we have received many rebuffs, but it is now time to increase the scope of our efforts a little, and try and get people acquainted with the ways of preventing fires within those fireproof structures and the destruction of any of their parts or ornamentation. . . . Perhaps after a few more years of persistent work we may get them to close up elevator and stair shafts in fireproof partitions and doors. . . . We may induce them to use fireproof materials in the finish of their rooms, some form of cement or tile floors instead of wood, metal furnishings instead of wood again. . . . There is but one method of building a fireproof structure that is compatible with safety and our necessities, one that will neither burn nor be materially affected by any fire within or without. . . . A structure whose frame is of steel, thoroughly protected with cement and incased entirely in hollow fireproof tile, whose floors are also of hollow fireproof tile arches, partitions of brick or hollow tile, and whose outer walls are of brick or terra cotta—not stone or granite, because both of these are actually dangerous in a fire. . . . But the work of education must be by easy stages, and we must give these things to the people in small doses; to attempt to get any one to build anywhere near perfectly at one fell swoop would be an overdose, and you know what overdoses usually lead to." With all the lessons of the Baltimore fire now before me, I cannot think of anything I would care to add to the above, written months ago, and preached for years back.

The perfectly fireproof building above alluded to, fireproof in the sense that the average man interprets the term (in that no damage can be done to the building by fire, and that all he may put within that building is absolutely safe from external attack) *is* possible. I could build a structure, a skyscraper, upon which even an inferno like that at Baltimore would not inflict more than a few hundred dollars' worth of actual damage. But who in these times of careful calculation of dividends and returns upon investments would pay for such a building? I would build its exterior all of brick or hollow tile, and with molded brick trimmings, and some little terra cotta ornamentation, more carefully made and burned than the usual commercial terra cotta; not a particle of marble, stone, or granite would be outside of that building. I would make the frame of steel, just as we do to-day and no heavier, and I would carefully incase all that steel in tile, a trifle heavier and thicker than is the average on the market to-day; the floors would be of hollow tile arches covered with cement, or tile, or marble—no wood; all the window and skylight frames would be of metal covered with a heavy asbestos covering; all the windows and skylights I would doubly glaze with wired glass; all the casings and finish would be of cement, and the doors of metal, and each story cut off from the other absolutely, no open elevator or stair wells. Such a building, with the ordinary precautions, suggested by the average intelligence, closed windows and some water and other fire-fighting appliances within, would have withstood that fire in Baltimore unscathed, and would have protected all that might have been within it from damage in spite of the nearly 3,000 deg. of heat developed at some points during that fire!

But the exigencies of the time seem not to permit so perfect a structure. Even fireproofing tile has been reduced in thickness to its minimum ability to withstand ordinary fire; the trade demands it; people will not pay for more tonnage. Everything that goes into a building has to be pared down and shaved, particularly in the structure, so that there may be profit in renting the building. If there is anything upon which money is spent at all lavishly, it must be fine carvings on the outside, and rare marbles, and polished woods inside, things that catch the eye and give an apparent value to property. Natural enough, but lamentable just the same, and in Baltimore's case, at least, exceedingly expensive ultimately.

Architects are too prone to take certain standards of make of any material and use it everywhere regardless of varying conditions. Now, as I said before, in the upbuilding of this district of Baltimore, or in building in sections in other cities that are pretty well filled with good buildings, mostly fireproof structures, nothing more is needed than was used in Baltimore's skyscrapers we now have under consideration. But in crowded districts of comparatively flimsy structures, in just such a place as were those very buildings in Baltimore, and in other old cities where like conditions exist, or in New Orleans, or San Francisco, or Boston, or in some parts of New York, or in any other extra-hazardous positions, in Heaven's name why not take *extraordinary* precautions, and use a heavier and thicker tile in floors and in incasing the steel; wired glass on the exposed fronts, and at least metal frames at such exposed windows; why should not every precaution be taken that experience teaches us is necessary, or that even tends to minimize the damage that could be done by just such another conflagration?

A careful examination, such as I have made of that entire district, was immensely interesting and certainly helpful in developing any Sherlock Holmes propensities one might have. So many seemingly inexplicable things happened, what might be termed freaks of fire, and yet, if one knew all the circumstances, and put ones and twos enough together, most of those freaks could be readily explained. The escape of certain small buildings from almost any damage, the abrupt cutting of fire at some one point where no insuperable barrier presented itself, the skipping of flames over large areas seemingly drawn to some particular point of attack, high up in the air and not along the prevailing direction of the wind, while another fire was more slowly eating into the very foundations of that same building; the peculiar forms of some of the ruins, setting at naught the very first principles of statics—all of these strange things were, as I say, fascinatingly interesting, and will be food for thought and study and experiment and much theorizing on the part of those scientifically inclined, and will ultimately, of course, prove of considerable benefit to the world. I saw in one place three brick arches resting on columns of granite that had been completely eaten away, yet the arches stood absolutely intact and carrying a considerable weight above them and without a particle of support under the two central skewbacks; these arches apparently reflecting into one structural supporting arc sustaining the pendative load at the two intermediate points by mere adhesion.

A considerable portion of the Custom House now under construction will have to be torn down. In one place there is a granite cornice temporarily covered with planks; the planking is not even scorched, while the granite underneath it is shaled off, cracked, and badly scaled. Most of the damage was by heat unaccompanied by flames. Some of the ironwork inside not yet protected with fireproofing will also have to be taken down. The handsome marble court house, recently completed, was somewhat damaged externally. It was just outside of the zone of fire, but received a hot enough blast to damage its stonework to the tune of $75,000 or so.

In Baltimore, as everywhere else, there was and is some lamentable negligence in the way of superintendence, which simply goes to prove, as I have always contended, the folly of using any material whose safety in construction depends absolutely and solely upon perfect superintendence. For instance, in the Continental building the brickwork is of course carried from story to story. I noted great patches on the side walls some thirty or more feet in length by the full height of a story, where the entire facing course of brick had been detached and had fallen off, showing that in all that extent of wall there was not a particle of bond, either of metal or of brick, between that course and the backing. Such work as that and the allowing of marble workers, and steam fitters, and other craftsmen to ruthlessly break through flooring and cut everything to pieces, in order to install their work with greater ease, is certainly shameful, and shows culpable and criminal negligence on the part of the superintendent who allows it.

In the fireproof buildings, most of the partitions were in most excellent shape, but I noticed in one that whole sections of partition were on the floor, in connected condition, and not in the shape they would have been had they fallen there. It seemed a case of their being thrown down by some terrific force. The fire could have had no such effect unless the draft was even greater than the maximum of my calculation—the rate of 180 miles an hour was undoubtedly reached—and it certainly was not the work of the firemen. Insistent investigation showed me that they had tried to cut off the fire near that point with dynamite, and it was these series of explosions so near that had thrown down section after section of those partitions in such peculiar shape and manner.

A considerable part of the front wall of the Union Trust building will have to be taken down. The steel frame in that outer wall was not carefully enough protected, so that the heat has warped it, and as a result that front wall is distorted into all sorts of shapes. It is in a dangerous condition. The interior framing is, I believe, in perfect condition.

It is to be regretted that there were no important or tall concrete constructions in that zone of fire. Had there been, we certainly would have had a good basis of the comparative value of that mode of construction. There was but one concrete building that I could find. There may have been others that were destroyed, but the one I examined was about 30 by 75 feet, four stories high, built on the Hennebique system, and it seemed fairly intact, except in one or two of its concrete beams. The condition of the iron front shows that there was a quick attack of flame, and it is evident that there was comparatively little combustible material within the building, because even the gas pipes are in fairly good shape. That the floors stood up while the wooden floors in the adjacent buildings were destroyed proves that the system is certainly better than wood—if the building can be completed without collapsing; but that this was a test of what it would do in a tall construction or in a more exposed place is stretching the point to its utmost elasticity. That the heat and flame in that one section, as in some other low points, were comparatively quickly over and not of the most intense, is shown by the condition of the metal in this building, and by the fact that directly across the street, in one of the fireproof skyscrapers, the Maryland Trust building, for the same height up, four or five stories, the decorative plastering on the ceilings is not even charred, and some of the light fixtures are hanging intact. The fire seems to have swept by at frightful velocity, quickly devouring all woodwork and anything combustible, but leaving even the concrete and plastering in pretty good shape. The plastering and everything else in the Maryland building above the fifth floor show that the heat was vastly more intense above the line of that concrete building. I should imagine that the heat at that one point was not over 600 deg.; at the seventh and eighth floors in some of these skyscraper buildings, it must have reached nearly 3,000 deg., because I found in one place a safe that was not only warped all out of shape, but one of its angles, that nearest the window, was fused, molten down, and had trickled much as candle grease does over a candlestick. Again, at the twelfth and topmost stories I noted that some brass had but begun to fuse alongside of some cast iron that was badly warped, but had not nearly reached the fusing point. The heat there was certainly not over 2,000 deg., while in other places on the top of three and four-storied buildings I found lead that showed no signs of fusing, all of which would indicate that the heat was most intense at the point where the first blast of flame struck those tall buildings. The resulting variation of temperature in the height of these skyscrapers was enough, one would think, to distort the steel whatever it might be incased in or protected with.

The owners of these skyscrapers may feel somewhat aggrieved that their buildings, being called "fireproof," did not meet the popular interpretation of that term, and safeguard not only the structural parts, but all the goods and inflammable materials within and about the buildings. And they may, and with justice, feel abused in that their architects advised the use of granite or stone exterior walls, when they ought to have known that a much lesser fire even would play havoc with those materials; but after viewing the absolute destruction of everything else in their vicinity, upon more mature reflection, and realizing the terrific and unexpected test their buildings passed through, something that neither they nor their architects ever dreamed of or deemed possible, and that we have been laughed at every time we suggested, they must appreciate that amid all that desolation they alone have any cause for thankfulness, for their buildings may be repaired and refitted ready for tenants long before their neighbors can possibly hope to complete new and much smaller buildings.

Much is to be learned from that fire in the way of improving methods to fight fire, bettering water systems, and all that sort of thing; but as far as the actual science of building is concerned, that fire may do a general good in that it will open the eyes of the people to the advantages of building as we suggest, using the materials we advise and taking the precautions against fire that we have urged for years; but, I frankly confess, it neither revealed, demonstrated, nor proved anything engineers and fireproof specialists did not know before and have so persistently advocated heretofore. With the results of that fire clearly laid out before me, I would not change in the slightest particular any steel framing I have on hand, nor would I change the standard patterns for fireproofing floors, partitions, column coverings, etc., except to slightly increase their thicknesses for extraordinarily hazardous risks—as all sane men would do anyway—nor could I advise anything better in interior finish, in the glazing of windows, and the hundred other minutiæ and detail of building, than I have advised and used prior to that fire. The trouble is not with the engineers, the teachers, but with the refractory pupils, upon whom even such a lesson is liable to make small impression. In so far as the theories we have preached and practised have been applied in the structures that have so successfully passed through the test of the Baltimore fire, are we fully vindicated in our beliefs, and have we just cause for jubilation; for we may now demonstrate the soundness of our contention, when questioned by the skeptical or doubting ones, by merely pointing to the steel, tile-incased structures that resisted and were the victors in the mighty battle that was waged against them at Baltimore February 7, 1904.

THE WRIGHT EXPERIMENTS IN FLYING.

IN October last we resumed the trials on the Kill Devil practice ground with the machine which we had used during the previous year, and succeeded in making flights in which the operator remained in the air over a minute, at one time being suspended 1 minute, 11.80 seconds. While carrying on the experiments, our power machine was under construction. In dimensions it measures a little over 40 feet from tip to tip of the wings, of which there are a pair. Its length fore and aft, to use a nautical phrase, is about 20 feet, and the weight, including that of the operator, as well as the engine and other machinery, is slightly over 700 pounds. We designed the machine to be driven by a pair of aerial screw propellers placed just behind the main wings. One of the propellers was set to revolve vertically and intended to give a forward motion, while the other underneath the machine and revolving horizontally, was to assist in sustaining it in the air.

We decided to use a gasoline motor for power, and constructed one of the four-cycle type, which, revolving at a speed of 1,200 revolutions a minute, would develop 16 brake horse power. It was provided with cylinders of 4-inch diameter and having a 4-inch stroke and intended to consume between 9 and 10 pounds of gasoline an hour. The weight of the engine, including the wheel, is 152 pounds.

We had calculated that this amount of mechanical power would be sufficient to maintain the machine in the air, as well as to propel it, the calculations being the result of gliding experiments, which showed that

when the wind was blowing at a rate of 18 miles an hour, the power consumed in operation was equal to 1.5 horse power, while, with a wind of 25 miles an hour, 2 horse power was absorbed. Our machine was capable of sustaining a weight of 160 pounds per horse power at the 18-mile rate.

After the motor device was completed, two flights were made by my brother and two by myself on December 17 last. The apparatus had been placed on a single-rail track, built on the level, the track supporting it at a height of eight inches from the ground. It was moved along the rail by the motor, and after running about 40 feet ascended into the air. The first flight covered but a short distance. Upon each successive attempt, however, the distance was increased, until at the last trial the machine flew a distance of a little over a half mile through the air by actual measurement. We decided that the flight ended here, because the operator touched a slight hummock of sand by turning the rudder too far in attempting to go nearer to the surface. The experiments, however, showed that it possessed sufficient power to remain suspended longer if desired. According to the time taken of each flight a speed varying from 30 to 35 miles an hour was attained in the air.

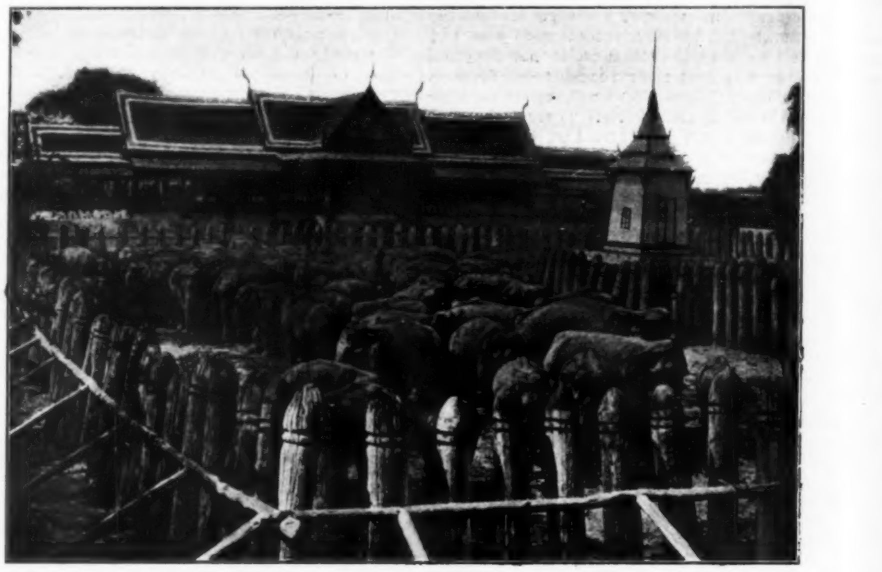
We should have postponed these trials until the coming season, but for the fact that we wished to satisfy ourselves whether the machine had sufficient power to fly, sufficient strength to withstand the shock of landing, sufficient capacity to control. Winter had already set in when the last trials were made, but these facts were definitely established, and we know that the age of the flying machine has come at last.—Wilbur Wright, in the Independent.

A CAPTURE OF ELEPHANTS AT THE KRAAL OF AYOUTHIA, SIAM.

SIAM is one of the countries of Asia in which a great many elephants are still met with in a wild state. In many of the provinces of this country, these animals alone are capable of being used as mounts and beasts of burden by travelers through the forest and bush. And it is these animals, too, that, through their strength and intelligence, permit of the exploitation of the vast forests of the north. So, from time immemorial, it has been customary to capture young elephants and train them for various purposes.

The kings of Siam, of whom the elephant was about the only mount up to scarcely a century ago, were accustomed to capture entire troops of these pachyderms from time to time, and then turn them loose after picking out the young males adapted for training. The present king, Chulalongkorn, continues the tradition, less by necessity than for pleasure, and, every three years, organizes a wild-elephant hunt in the kraal of Ayouthia. A kraal is a special inclosure. Ayouthia is a small town about 75 miles north of Bangkok.

The real hunt, that is to say, the heading of the wild animals toward the kraal, usually lasts five or six months, and all the large males provided with tusks and kept in the royal stables are employed in it. The scattered elephants, which live in families of twelve or fifteen individuals in the wooded plains of the East, are slowly driven toward the Menam. The line of the huntsmen, which is at first very long, is gradually contracted as it advances toward the west, so as to bring together all the dispersed families within a given radius. During this operation the huntsmen take care to put to flight all the large males armed with tusks, and preserve only the females and young, and a few larger males destitute of tusks. Such selection and assembling are, of course, very slow operations, since it is necessary to avoid frightening the defiant pachyderms, lest they break through the line of the huntsmen and flee to great distances. After a few months of slow march, the pachyderms, united into a troop of from two to four hundred individuals, reach the vicinity of the left bank of the Menam. The huntsmen so arrange things as to arrive there at the epoch of low water, in order that the elephants may ford the different branches of the river without difficulty. This obstacle surmounted, the animals are gradually driven into the vast plain of the right bank, at one of the extremities of which is constructed the kraal, called by the Siamese a "paniet." Here they remain, guarded by domestic elephants, until the time fixed for the capture.

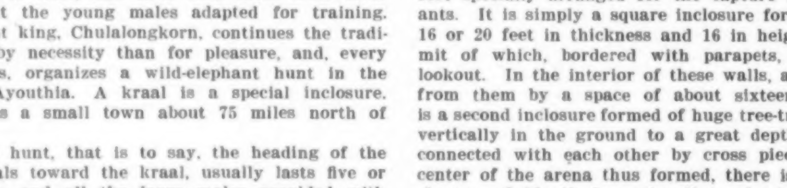


WILD ELEPHANTS COLLECTED IN THE KRAAL.

The paniet, which is separated from the plain occupied by the elephants by a "klong" (canal) about sixty feet in width, is composed of two distinct parts—a vast funnel-shaped inclosure and the kraal properly so called. This latter consists of an old dismantled fort specially arranged for the capture of the elephants. It is simply a square inclosure formed of walls 16 or 20 feet in thickness and 16 in height, the summit of which, bordered with parapets, serves as a lookout. In the interior of these walls, and separated from them by a space of about sixteen feet, there is a second inclosure formed of huge tree-trunks planted vertically in the ground to a great depth and firmly connected with each other by cross pieces. In the center of the arena thus formed, there is a small inclosure, of identical construction, about sixteen feet square. Perpendicularly, and in the center of each of the sides of the square, three or four tree-trunks are deeply planted. One of the sides of the walled inclosure of the kraal is occupied by the royal pavilion. In the center of the wall, opposite the king's lodge, is the entrance to the kraal, communicating directly with the funnel-shaped inclosure. It is a passage 8 feet in width, cut in the wall and continued to the inner inclosure by a passageway formed of trunks of teak trees. The same arrangement exists for the exit of the elephants in the corner on the right of the royal lodge. These passageways are inclosed by gigantic trunks of teak planted vertically in the ground, and the intervals between which are filled by strong posts 10 inches in diameter and 10 feet in height, firmly connected with the trunks by transverse beams, and braced on the outside with inclined beams. The large trunks, which rise about 23 feet from the ground, are connected with each other, at their summit, by a framework of huge beams solidly bolted and forming a vast quadrilateral upon which stand, out of reach of the elephants, half a score of men armed with long lances. The whole, therefore, forms a sort of open passageway in which there is just sufficient space to allow an elephant to pass, but not to turn about. Between the first and second trunk, on each side, at the two ends of the passageway, there are two movable trunks firmly suspended from the upper framework, but with their bottom ends slidable in a spiral groove, so that the trees, in separating from each other, form a right angle under which the elephants can pass. This is the door of the trap. When it is desired to close it, the trunks are allowed to fall so that they approach one another and assume a practically parallel position, close together. The handling of these heavy masses is effected by means of capstans.

The exterior part of the paniet is a vast inclosure of triangular form, constructed of trunks of teak planted to a great depth in the ground, and divided into three compartments by barriers of analogous construction that leave passages wide enough to allow six elephants to walk through abreast. The entrance to this funnel is near the base, upon the left side of the triangle.

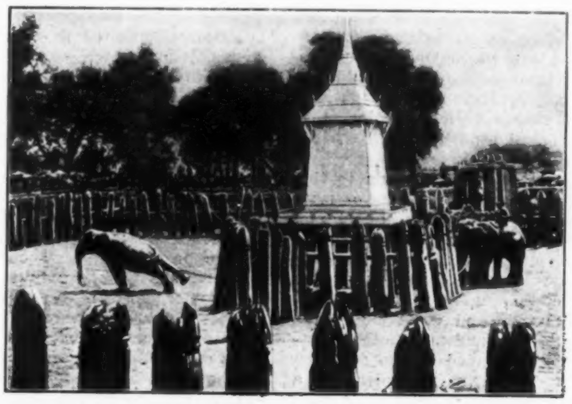
Upon the first day, at a signal, the entire troop of wild elephants, under the escort of the old trained males, begins its march toward the kraal. Three or four huge elephants from the king's stables precede and seem to guide their wild companions. Reaching the steep bank of the river, the guides descend to the water, and crossing, arrange themselves in battle array on the opposite side. The troop of wild elephants, after a little hesitation, cross the river in turn, and after reaching the shore endeavor to flee toward the forest; but, arrested by the tusks of their guardians and the lances of the drivers, they fall back and seem to consult with each other. Finally, after several futile efforts to escape, they decide to follow the sole passage left free, which leads them into the first compartment of the funnel-shaped inclosure. Ten minutes later the entire troop is in the first part of the teak inclosure, which has the form of a trapezium. Finally, preceded by the large domestic males as guides, two or three of the pachyderms advance into the second compartment, where they are soon joined by the entire troop. They are now captives; but, since the trunks of teak, as strong as they are, could not long withstand their furious onslaughts, they have to be forced to advance into the funnel and thence into the kraal. After much hesitation one of the captives, bolder than his fellows, decides to follow the three guides into the funnel, and the entire troop soon imitates him. At the entrance to the passage cut in the wall, he hesitates again, but thinking that he sees liberty awaiting him at the end of the passageway, he darts forward with head lowered and the utterance of a sound resembling that of a trumpet. Several others, probably belonging to the same family, quickly follow him. Unfortunately, the rest of the troop halts again. Meanwhile, a new family enters the narrow passageway after a repetition of the same scenes, and then, finally, the entire troop. The passage of these huge beasts takes fully half an hour, and then the trap door falls heavily behind the last pachyderm to enter the kraal. The first animal that enters the arena traverses it on a trot, looking about everywhere for an exit. After finding that his efforts to escape are useless, he trumpets, stamps, strikes the ground with his trunk, and finally places himself facing the spectators and with his rear end resting against the central redoubt of tree-trunks, where he remains immovable. The succes-



INCIDENTS OF THE CAPTURE ON THE PLAIN. THE WILD HERD REPULSED OR ARRESTED BY THE LANCES OF THE ELEPHANT DRIVERS.

sive incomers repeat the same performance, and then arrange themselves alongside of their fellow. The three large tame males then leave the kraal, and the prisoners are finally fed.

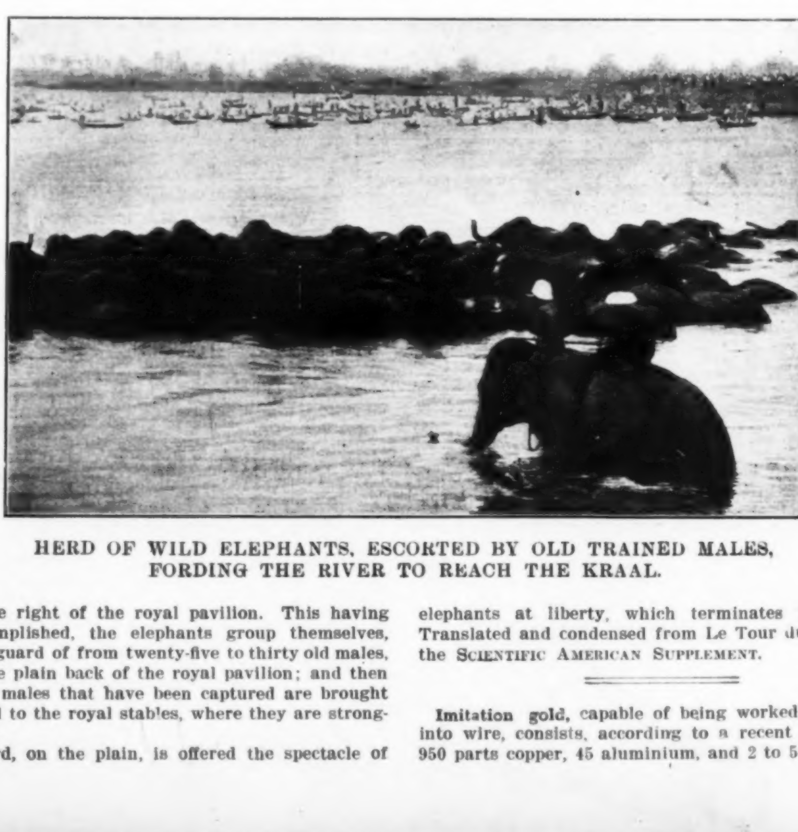
On the second day a selection is made of the animals adapted for training and which it is desirable to keep



A CAPTIVE ATTACHED BY A LASSO TO THE SMALL PAGODA OF BUDDHA IN THE CENTER OF THE ARENA.

captive. For this purpose, young males with growing tusks and nurslings of the same sex are chosen, since it is very difficult to train an adult that has become habituated to a wild and free life. Along about half past twelve eight large domestic males successively enter the arena, each carrying two men, one seated upon the animal's neck and the other upon its crupper. The first is armed with a long, sharp, iron lance, and the second holds in his hand a long piece of wood, one of the ends of which is curved at an obtuse angle. It is by means of this that he guides his huge mount. A long, strong rope is coiled up upon the back of the pachyderm, to the belly-band of which one of the extremities is firmly secured, while the other extremity terminates in a slip-noose. The latter is loosely fixed to the lower extremity of the lance and carried by the driver seated upon the back of the animal. The domestic elephants, guided by their driver, penetrate the crowd in search of the victims doomed to captivity. Coming up to the side of the animal to be captured, the man seated on the neck of the tame elephant endeavors to secure one of the hind legs of the victim with the noose of his lasso. Having succeeded in doing this, he pulls the cord in order to tighten the knot. Then turning his elephant about, he heads him toward the royal lodge. The rope, firmly secured to the belly-band of the tame elephant, abruptly tautens, and the captured beast falls upon its knees in the midst of its fellows, trumpeting loudly. After these preliminary operations are finished, two of the domestic males approach the captive, which the drivers, by means of strong ropes, attach by the neck and body to their elephants. Then the latter, one on each side, begin their march toward the exit of the kraal. The prisoner resists, allows himself to be dragged along, and sets up a terrible trumpeting; but it is of no use, he has to move along. A third trained animal, placing himself behind the captive, lifts him and thrusts him forward with the ends of his long tusks.

Now remains the difficult task of causing the wild troop to make its exit through the narrow passage-



HERD OF WILD ELEPHANTS, ESCORTED BY OLD TRAINED MALES, FORDING THE RIVER TO REACH THE KRAAL.

way on the right of the royal pavilion. This having been accomplished, the elephants group themselves, under the guard of from twenty-five to thirty old males, in the little plain back of the royal pavilion; and then the young males that have been captured are brought out and led to the royal stables, where they are strongly secured.

Afterward, on the plain, is offered the spectacle of the capture of a young elephant. Everything takes place here in the same manner as in the interior of the paniet; but, since the space is greater, the operation is more difficult, because it is easier for the animal to escape the fatal noose. During this interesting spectacle, several of the wild beasts charge the crowd, but are always stopped in the nick of time by the tusks of the big males of the royal stables and the lances of the drivers. The young male captured is led, despite his resistance and protests, to the royal stables, where he is firmly secured by his four legs to posts arranged for the purpose, while the troop, under guard of the tame pachyderms, are led to the river back of the

A PORTION OF THE WILD HERD TAKING A BATH.

kraal, where they are allowed to take a bath, after which they are made to ascend the bank and march through the plain along the wall of the kraal to the mouth of the funnel, which they are forced to enter in order to reach the paniet.

The programme of the third day is about the same as that of the second, aside from the setting of the elephants at liberty, which terminates the hunt.—Translated and condensed from Le Tour du Monde for the SCIENTIFIC AMERICAN SUPPLEMENT.

Imitation gold, capable of being worked and drawn into wire, consists, according to a recent formula, of 950 parts copper, 45 aluminium, and 2 to 5 of silver.

REPTILIAN TYPES: THEIR ORIGIN AND FATE.*

WHEN superficially examined, birds appear to be very different from reptiles; but there is scarcely an important fundamental character in which all birds differ from all reptiles. Practically, the only one is the fact that birds possess feathers and reptiles do not. The dermal covering of reptiles, when they possess one, is always in the form of scales; that is, simply flat flakes; whereas birds are covered with finely subdivided dermal appendages, which have that complicated structure which we all know in the case of feathers. Birds are all warm-blooded; that is a feature which distinguishes them clearly from all reptiles so far as we know; but that is a character which, from an examination of those modifications in other groups, has not been found to be of much zoological importance. So closely related, then, are birds and reptiles, that practically all zoologists at the present time and for the past thirty years have united them in a single large group, among the various designations for which is Sauropsida (a term created by Huxley) and Monocondylia (per Haeckel and Cope).

The basal portion of the axis of the skull of the Reptilia is a fully ossified region; in the Batrachia and fishes that region is not bony, but simply cartilaginous; but in the latter groups this floor of the skull is covered in from the under side by a thin superficial plate of bone (the parasphenoid) which is not represented in the reptiles. Another important characteristic is that the nodule of bone (the occipital condyle) by means of which the skull is articulated with the vertebral column is single in the reptiles and likewise in the birds (whence the term Monocondylia); whereas the skulls of Batrachia and mammals are always articulated to the vertebral column by means of two occipital condyles.

There are many fishes in which the bodies of the vertebræ are made up of two disks, one of which bears an arch above; that is, alternating ones bear an arch above (the neural arch, protecting the spinal cord) and the others bear arches below (representatives of the ribs or their equivalents). In the Batrachia the alternating pieces corresponding with the ribs gradually become smaller and smaller. In the Reptilia and in the birds and mammals the bodies of the vertebræ are formed through the enlargement of the alternating pieces, while the pieces which represent the vertebral bodies in the Batrachia disappear; consequently, the vertebral bodies of reptiles and all of the higher land animals are something totally and fundamentally different from those in the Batrachia.

Without going more fully into the characters of the reptiles, there is no question but that reptiles as a group have originated from the large group of Batrachia existing in the Carboniferous period. All of that group have become extinct; but some obscure member thereof evidently contained the spark of progress; and from that unknown member all of the higher land animals now existing have originated. The first to do so were certain primitive reptiles; and this origin of the reptiles—of the Stegocephala—took place back somewhere in the Carboniferous period, although none of the reptiles have been found until the period—the Permian—next succeeding the Carboniferous. In the Permian we find a great many extremely primitive reptiles.

Unfortunately, the material by which these reptiles are represented is almost always in a very fragmentary condition, and the rock in which the remains are found is of such a nature that it is extremely difficult to chisel out the bones; consequently, our knowledge of these primitive reptiles has not advanced nearly as rapidly as we could wish, and there is still a great deal of obscurity about the inter-relationships of the various reptiles which are found in that period. However, it is perfectly clear that some of them scarcely differ from the stegocephalian Batrachia; they differ from them only in those characters which are known to be essentially reptilian (that is, the single occipital condyle, certain peculiarities of the bones of the wrist and ankle, and other features of that

* A lecture delivered at the Academy of Natural Sciences, Philadelphia, by J. Percy Moore.

sort), so that we know certainly that they have diverged from the Stegocephala far enough to be called true Reptilia. There are other reptiles in this same period which differ more or less from these most primitive ones, so that it is evident that they are diverging from the primitive stock; and it is with regard to these that the difficulties in classification have arisen. The best guide to the classification of the large groups or orders of reptiles is to be found in the changes which have taken place in the posterior region of the skull.

Now in the Stegocephala the exterior of the skull presents a series of bones (six or seven) joined together to form a complete bony roof, which is entirely distinct from the true brain-case. That is, we find a true brain-case, and on the outside of that, borne some distance from it by arches of bone, a second. In the stegocephalian Batrachia the temporal roof is perfectly complete, and is made up of a considerable number of bones. In the most primitive reptiles we find exactly that same condition persisting; all of the bones which are found in the stegocephalian temporal roof are found also in the earliest and most primitive order of reptiles; but it is in the region of that roof that the principal modifications of the skull of reptiles take place. In a modern reptile—say a lizard, or still more in a snake—the greater part of that temporal roof has disappeared. We find some remnants of it in this narrow arch here. In the skull of a snake you look directly down on the brain-case, just as in the skull of a mammal; there is absolutely none of the temporal roof left; but in these primitive reptiles the temporal roof is complete.

Modifications of this temporal roof take place in various ways; and it is the manner in which this roof becomes modified that has led to the separation of the Reptilia into different ordinal groups.

Openings or foramina may appear between the bones—that is, where the bones articulate; and by the increased size of these foramina the bones of the skull are gradually encroached upon, the openings becoming larger and larger until very little remains of the bones of the temporal roof of the skull except narrow bands. You take an animal like this, and looking at the skull from the upper side, you notice in here the region of the brain-case; then just outside of the brain-case a great opening into the temporal fossa onto the temporal muscle or chewing muscle, then still farther out toward the sides of the skull a narrow opening. All that remains of that temporal roof is a sort of a framework consisting of an arch which passes back from the orbit and a still lower arch passing back along the region of the upper jaw, continuing the upper jaw backward. Those two are united in one another, and united with the central part of the skull or the brain-case by a posterior arch. Now, that is one modification—and a very important—which characterizes the whole series of reptilian orders.

Beginning at the bottom of a phylogenetic or ancestral tree, we have the stegocephalian Batrachia as the original stock from which the Reptilia sprung. From this central stock originated an order or group of forms differing very little from the Stegocephala, and known as the Cotylosauria. Its specific characteristic is that the members of this group possess a bone (the tubular bone) on the posterior edge of the temporal roof, which is not found in any other reptiles, but which is found in all of the Stegocephala. The Cotylosauria is the central order from which all reptiles came; that is, the original and primitive reptilian stock. There is no doubt whatever about that. In the same formations in the Permian in this country, and in South Africa, and at one or two places in Europe there have been found a large number of remains of reptiles which are primitive in a great many respects. These reptiles have been grouped in two orders: First, the Pelicosauria, and from that the group Theromorpha. The Pelicosauria shows modifications in the direction of the development of the two temporal orifices; that is, we find the skull gradually encroached upon by openings in the temporal roof, with the result that there appeared two more or less distinct longitudinal bony arches.

In the American Pelicosauria—those which are found in this country, and particularly in the Permian of Texas, where they are very abundant—we find that these arches become more and more delicate; the whole posterior region of the skull (including the arch of the lower jaw—the quadrate bone which supports the lower jaw) becomes more and more attenuated; so that the jaw supports become weaker and weaker; at the same time that this was taking place, these animals, evidently from the character of their teeth, became more and more carnivorous and predaceous in habit. They developed very large canine teeth like those of our modern lions and tigers; their molar teeth developed a sharp cutting edge, like the scissor-like flesh-teeth of the cats; their incisor teeth became in many cases small, indicating also a flesh diet. These facts and the form of the articulation of the jaw caused the jaws of these animals to move always in a vertical direction; that is, no lateral movement in most of these forms is possible. In moving in that direction, and with the great development of the temporal muscles, the strain on these weak jaw-articulations must have been very great. Whether or not that is the reason these animals became extinct in America, the fact remains that they did become extinct. Of course, that is a serious structural weakness in the animals, and it may have been that which led to their extinction; anyhow, they became extinct.

In Africa, however, the members of the Pelicosauria underwent development in another direction: The quadrate bone, to which the lower jaw is articulated, became shorter and thicker; instead of being directed outward from the skull, as in the American representatives of the group, it was directed vertically; at the same time, the elements of these arches here, instead of becoming thin and attenuated, became stouter and firmer and inclosed the quadrate bone more and more. This process went on so far in fact that this opening gradually closed up, so that the infra-temporal orifice in many of these African representatives of the Pelicosauria disappeared, and so far as that was concerned, you see they reverted back to what was more nearly the original condition. All of that tended to strengthen this region.

Now, forms with those peculiarities led on to this next group, the Theromorpha—a group of very extreme importance in the history of the development of land animals. It is from that group almost unquestionably that the whole series of mammals sprung. Many of these forms tended in the direction of the mammals: That peculiar reduction of the quadrate; the character of the pelvis and of the ankle and wrist joints; the structure of the shoulder-girdle, and many other peculiarities of those animals all tended in the direction of the Mammalia. The Theromorpha underwent a very great development in various directions. Among other peculiarities we find some modifications of the teeth which are quite unique in reptiles. For example, there is a little animal about the size of a dog known as Galeocerus, found in the Permian formations of South Africa. The general form of the head of that animal is very dog-like. The quadrate bone has almost disappeared; it is so short, in fact, as to be invisible from a lateral view—this bone being carried back into the skull and covered in by remnants of the temporal roof, which has been so cut away that even in looking from the side the brain-case is visible. Here is a high crest for attachment of the temporal muscle, which is a very dog-like character. It also possessed five small incisor teeth on each jaw—a number higher than in any other mammal; also five large canines, and a series of molar teeth, the edges of which are compressed, knifelike, and serrated in a manner which must have made them very efficient as cutting organs. That animal was unquestionably a very agile carnivore, and it took very much the place in the fauna of that day that the dogs and cats do in the mammalian fauna of to-day.

In another (South African) form the specialization of the teeth has followed another course. The molar teeth have nearly all disappeared; the canines have become exceedingly large tusks, like the teeth, almost, of a saber-toothed cat, or tiger; the incisors have disappeared or become very greatly reduced. Following that along, we have a form whose upper jaw ends in a down-curved beak; the lower jaw bends up in a somewhat similar fashion, and thus arises a peculiar forceps-like formation entirely devoid of teeth, and evidently from the peculiar pitting and structure of the bone of that region, covered over by horn. Just what the animal fed on we do not know, but probably it was insectivorous.

The Pelicosauria presented also a number of peculiar modifications. Many of them were evidently burrowing animals. That is particularly indicated by the structure of their limbs. Almost all burrowing animals have a similar limb-structure, no matter to what group they belong. A great, broad, shovel-like hand terminates a flat, stout arm, whose humerus is provided with great projections, to which the enormous muscles required for burrowing were attached, the structure being very much the same as in our modern moles.

The genus Nanosaurus is especially remarkable along with some other Pelicosauria from the character of its vertebræ. That little dark spot is the opening for the passage of the spinal cord, and all the rest is the neural spine. In some of these forms the length of the neural spine runs away as much as twenty times the diameter of the body of the vertebra, the spine having lateral processes or projections sticking out from the side—half a dozen or so. It looks like the mast of a fully rigged ship. Just what purpose that served, of course we do not definitely know; undoubtedly, however, the back of the animal must have supported some sort of a very high crest—a great, integumentary fold of some kind; and Prof. Cope, who described the species Nanosaurus, suggested as a possibility that this may have been an animal which lived along the seashore, which frequently entered the water, and that possibly this crest served as a sort of a sail, by means whereof the animal was carried about by the wind. However, that is generally regarded as an extremely improbable explanation of the utility of this structure.

Reverting to the Theromorpha, with their differentiation of teeth, the shortening of the articulation of the jaw, and some other characteristics mentioned, indicating that this group is tending toward the Mammalia, we find in this same formation (the Permian) remains of certain animals regarded by some paleontologists as mammals, and by some others as Theromorpha. That is, they are so nearly intermediate in the characters which we know, that experts in the examination of these fossils find it practically impossible to definitely decide to which group they belong—showing how very close the relationships of these forms must have been. We do not find any absolutely undoubted mammals in the Permian formation, but in the Triassic (which next succeeds) we do find them; but we do find in the Permian forms, and closely associated with these remains of Theromorphs, many forms or some forms which may be mammals; so that this group is one which has a very considerable interest.

From the Pelicosauria we have passing a whole series of orders of reptiles which are characterized by that same peculiarity of two of these temporal foramina. The most primitive of these, and one which is closely connected in many ways with the Pelicosauria, is one which is known as the Rhyncocephalia, owing to a peculiar beaked condition of the snout in many of them. This group of Rhyncocephalia has a very considerable geological history. It branched out into a great number of forms—some of them away back in the Permian, others in the Triassic, and continuing with a series of remarkable modifications all through the Mesozoic formations; that is, a series of formations which consists of the Triassic, Jurassic, and Cretaceous; and some of them continue on down to the present time. The members of the Rhyncocephalia are very closely connected with the origin of other orders of reptiles. They undergo many modifications, occupying various habitats. A few of them were even aquatic; but most of them were land animals of peculiar characteristics, the most striking one (although in the superficial way) being that bending—the hooking—of the snout. Fortunately, we have one of these forms coming clear down to the present time, namely, the Sphenodon. This is extant only on a few islands off the New Zealand coast, and is very rapidly disappearing; so that in all probability the last remnant of the Rhyncocephalia will soon become extinct. The animal has an appearance very similar to a lizard, its length being about two and a half feet. It lives in dry sandhills. Most lizards and most snakes are active only in the bright sunshine, and just as soon as the air chills in the evening, they become sluggish; but the Sphenodon is nocturnal. It is generally very sluggish; but when in pursuit of its prey (small animals of various kinds, other lizards, and small snakes) it sometimes enters streams and catches fish. It lives in burrows, which are also occupied in many cases by a species of petrel—a small sea-bird which nests on those islands, and lays its eggs in the burrow with one of these animals. They seem to live very harmoniously together. The eggs of the hatteria or Sphenodon are also laid in these burrows, and are very remarkable in the great length of time required for them to hatch, namely, thirteen months. They are laid in the summer period (that is, during November, December, and January—the Southern summer) and they do not hatch until late in the following summer. They have a hard shell, like the eggs of many lizards.

There is very considerable diversity of opinion among zoologists with regard to the ordinal subdivisions of reptiles. That is owing chiefly to the difficulties of interpretation of those early, primitive forms; but certainly there are as many as twelve different orders, may be as many as fifteen. At the present time we have still living representatives of four orders. But two of these are represented—one (the Rhyncocephalia) only by this single form, which is about to become extinct; the other (the crocodiles) by a few remnants of what was once a very flourishing stock; consequently, the reptiles as a group are very poorly represented at the present day. Two orders—the turtles and the order containing the lizards and snakes—are represented by a very large number of species; but those are the only orders of reptiles which are at the present time flourishing. There is no other group of vertebrates which has been so heavily handled by time as the group of Reptilia. The group reached its highest development in the Mesozoic formations—in the Jurassic and Cretaceous. Here we find a vast number of species of reptiles of enormous size. Some of the reptiles of that period are by far the largest land animals which ever lived, their bulk many times exceeding that of an elephant. The Reptilia as a group are decadent; they have long ago passed their best days.

CONDITIONS IN MANCHURIA.*

THE BUILDING OF HARBIN.

ONE of the greatest achievements in city construction that the world has ever witnessed is now going on in the heart of Manchuria.

In the building of such cities as Vladivostock, Dalny, and Port Arthur, Russia has demonstrated her power and purpose on the Pacific in line with the world's conception of her character; but in the construction of this wonderful city of Harbin she is displaying an altogether different type of activity from what we are prone to attribute to her.

It is in this city more than in all the others combined that Russia is asserting her intention of becoming an active industrial force in the affairs of the Orient, and her people are already giving the place the title of the Moscow of Asia.

The city is located on the Sungari River, at the point where the Manchurian branch of the Siberian Railway crosses the stream and where the Chinese Eastern branch starts south to Dalny and Port Arthur. It is about 350 miles west of Vladivostock and 600 miles north of Port Arthur. Its location is the geographical center of Manchuria, and from present prospects it is to become the commercial center as well. The city is surrounded on all sides for hundreds of

* From United States Consul Miller, Niuchwang, China.

miles with a rich and productive agricultural country, producing corn, wheat, oats, barley, beans, millet, hemp, tobacco, vegetables, and some fruits. Minerals and timber and great areas of grazing lands also surround it.

At present the place consists of the old town, 3 miles from the central depot; Prestin, or the river town, the present commercial center; and the administration town, in close proximity to the railway station. Before the railway engineers established this as their headquarters there was no native town in this vicinity, and the entire place is therefore a Russian product.

Administration.—It is as distinctly a Russian city as though it were located in the heart of Russia, and none but Russians and Chinese are permitted to own land, construct buildings, or engage in any permanent enterprise. The city has been created by the Russian government, under the management of the Manchurian Railway Company. The land for many miles in each direction has been secured so as to make it impossible for any foreign influence to secure a profit or foothold close to the city, and foreigners are not recognized as having any rights whatever, but are permitted there by sufferance. The chief railway engineer is the administrator of the city, and up to the present time has had complete control of everything, but in the new scheme for the government of Manchuria some form of municipal organization will be permanently established.

Population.—In 1900 the place began to assume importance as a center of railway management, and in 1901 the population had grown to 12,000 Russians; in 1902, to 20,000; by May, 1903, to 44,000; and in October, 1903, a census showed a population of 60,000, exclusive of soldiers. Of these, 400 are Japanese and 300 of all other nationalities, including Germans, Austrians, Greeks, and Turks. All the rest are Russians. There are no Americans.

The railway and administration employes, including families, constitute 11,000 of the population. The Chinese population is about 40,000, located in a special settlement. The ratio of women to men is as follows: Japanese, 120 per cent; Russians, 44 per cent; Chinese, 1.8 per cent; average of women, 14.3 per cent.

Administration Improvements.—Harbin is the center of the entire railway administration of Manchuria, and, as the Russian commercial enterprises of the Far East are under the direction of the railway company, it will also be the center of Russian industrial and commercial development. It is the headquarters of the civil courts and the chief military post, and the main center of control of all the vast army of railway guards. The administration city, therefore, consists of all of the public and private buildings and shops necessary for these various departments. Residences for the employes cover the largest area of this division of this marvelous city.

The following are some of the principal buildings of the administration city:

Building.	Cost of buildings.	
	Rubles.	
Administration buildings three stories in height, having a total floor space of 3,600 square sagene (176,400 square feet), to cost when finished	1,200,000	$618,000
Railway shops	2,500,000	1,287,500
Hospitals	626,000	322,390
Commercial school and girls' school	500,000	257,500
Technical school	250,000	128,750
Eight schools for teaching Russians Chinese and for teaching Chinese Russian	96,000	49,440
Club and store for employes	370,000	190,550
Hotel	163,000	83,945
Russo-Chinese Bank	200,000	103,000

The total administration expenditure on the city has been 30,000,000 rubles ($15,450,000).

Transportation.—Steamers.—The Sungari River is navigable with light-draft steamers and native craft for nearly 200 miles above the city, up both branches of the river, and much traffic has already developed on these streams, especially in wheat.

From Harbin to the Amur River, during the navigating season, which begins in April and ends November 1, good-sized river steamers run daily. These steamers are well fitted with good, comfortable cabins for first, second, and third class passengers. They carry large cargoes of freight and usually tow barges loaded with freight. From Harbin to seagoing steamers at the mouth of the Amur cargo is carried now at 14 kopecks per pood, or about $4 gold per ton. The Chinese Eastern Railroad Company and the Amur Steamship Company run good steamers on this line, and there are also several private boats covering the same route. All are loaded continually to their full capacity.

The steamers are mostly of the stern-wheel type, burning wood, such as are in operation on the western rivers in the United States, but as far as I could learn none are constructed of American-made machinery. The time usually required to go from Harbin to Harborofsk, at the mouth of the Ussuri River, on the Amur, is five days. At this place these steamers connect with trains for Vladivostock.

Railroads.—Going west from Harbin the train takes you by a branch line from the crossing of the headwaters of the Amur to Stretensk, the head of navigation of this great river, while the main line goes to Lake Baikal (Siberia) and Russia. Going east, the railway reaches the sea at Vladivostock over a grade that does not exceed in any place 13 feet to 1,000. Going south, the Chinese Eastern Railway meets seagoing ships at Niuchwang, Dalny, and Port Arthur. The heaviest grade on this line is 9 feet to 1,000, and that for only a short distance and at rare intervals.

In October, 1903, the regular number of trains dispatched for through traffic was thirty per day. Eighteen local trains were dispatched in addition. These local trains connected the two extremes of the town, viz., the old town of Prestin with the administration part of the city.

Industries and Improvements.—Harbin was started primarily as a military center and an administration town for the government and direction of railway affairs. Its growth into a splendid commercial and manufacturing city was not originally provided for by the promoters and it has been somewhat of a surprise to them, but the fever of making it a great Russian commercial and manufacturing city has now taken possession of the railway management and every system of promotion and protection that can be devised to increase its growth along these lines is being energetically encouraged.

The capital for most of the private enterprises is furnished by Siberian Jews. Chinese are furnishing money for the construction of some of the finest private buildings, such as hotels, store rooms, etc. In the administration part of the city no private buildings of any kind are permitted.

The old town was the first to be laid out and the land was sold to the public at the rate of 1 ruble (51.5 cents) per square sagene (49 square feet) the first year, but this rate is now increased to 3 rubles ($1.55) per square sagene. Following this, in 1901, the administration town was laid out and construction work begun on buildings covering 20,000 square sagene (980,000 square feet). Later, the river town Prestin was laid out and in a very short time all of this was sold at a price of 17 rubles ($8.70) per square sagene, and most of it is now covered with substantial brick structures, there being 850 buildings, constructed at a cost of 8,000,000 rubles ($4,120,000). Recently two very large additions were laid out adjoining the administration town and the land has been sold at prices ranging from 5 to 15 rubles ($2.57 to $7.73) per square sagene. This was purchased largely by speculators and is being bought from them now at from 20 to 40 rubles ($10.30 to $20.60) per square sagene (49 square feet).

The administration has already received over 2,000,000 rubles ($1,030,000) for land sold to private parties. Many elegant residences and substantial structures are in course of construction in the additions adjacent to the administration town. A hotel and theatre combined was built at a cost of 60,000 rubles ($30,900) and rented for 25,000 rubles ($12,875) per annum.

All of this land is secured on an eighty-six years' lease.

RUSSIAN INVESTMENT IN MANCHURIA.

The chief engineer, who was in charge of the construction of the Russian railways in Manchuria, informed me that Russia had expended in railways in Manchuria 270,000,000 rubles ($139,050,000). Add to this her investments in fortifications and in the construction of the cities of Port Arthur, Dalny, Harbin, and other places, and it is a very moderate estimate to place her investments in permanent properties in Manchuria at a total of 500,000,000 rubles ($257,500,000).

RUSSIA'S COMMERCIAL ADVANTAGES.

A study of conditions in Vladivostock, Harbin, and other districts is not particularly encouraging to the idea of extension of American trade in Manchuria in any line that Russsia is prepared to supply. A knowledge of the earnest intention of the Russo-Chinese Bank to press the sale of Russian goods, a slight insight into the methods and determination of Russian railways to find a market for the products of Russia, and the interest displayed in developing resources along their lines for Russians and Chinese only, taken in connection with the natural wealth and resources of the country, do not favor the hope that under a Russian *régime* our trade in Manchuria will be as large as it was before.

If we take into further consideration the fact that the Russian government—by subsidies and bounties and through its banks and railways—is engaging in industrial and commercial pursuits as a government, and calculate the cheap food, cheap and reliable labor, and the vast mineral resources that she will have at her command on the Pacific, the question of the Manchurian market becomes comparatively insignificant and we find ourselves face to face with the greater problem of the markets of all Asia.

With millions of cheap and efficient Chinese laborers, with vast coal fields bordering on the Pacific, with mountains of iron and copper, vast forests, and enormous areas of agricultural land—producing now the cheapest food in the world—what is to prevent Russia, if her apparent plans are realized, from becoming a dominating factor in the commercial development of the Far East? One can not view the marvelous growth of a city like Harbin or observe the cities of Vladivostock, Dalny, and Port Arthur and the great Siberian Railway without pondering seriously the meaning of it all in the future of Russia on the Pacific.

For the present, the prospect is that we shall at least meet with such unfavorable conditions in Manchuria as will endanger our present lines of trade. Whether or not this will be compensated for by an increase in other lines is not at this time clear.

There ought to be, and most likely will be, a large trade in agricultural implements. Of foreign countries, Germany is securing the most of this trade now in Siberia and Manchuria, and there is no doubt whatever but that German trade is benefiting enormously by Russian domination of Manchuria. Next to the Germans come the Austrians, and next to them the Danish.

It is not in the least inspiring for an American to go through as busy and active a trade city as Harbin and find so few things from his country and not a single American citizen or progressive business house. The vision of the 75 per cent of American imports into Manchuria dwindles to a most insignificant amount. When you see the great flour mills continually enlarging and increasing in number, when you see the numerous breweries being constructed, when you see Russian engines, and German, Austrian, and Danish machinery and products, and hear of the successful development of Russian lumber mills and the introduction of Russian cotton goods, and see in the Chinese stores Russian oil and cigarettes where before were American, and where you hunt with straining eyes to find something from the United States, one is not seriously impressed with the statement that, under Russian occupation, our imports into Manchuria are sure to increase.

Unfortunately, the only customs returns by which we can measure our trade year by year in Manchuria are from the port of Niuchwang, and even that is very imperfect, for the imports all come from Japan, Hongkong, and other Chinese ports, and the place of origin of the goods is not given in all cases. Goods are coming into Manchuria in great quantities through Port Arthur, Dalny, and Vladivostock continually, as well as through Niuchwang, but there is no means of securing a proper report of them.

BEHAVIOR OF SELENIUM WITH REGARD TO LIGHT AND TEMPERATURE.

THE experiments described by R. Marc in a paper recently published in the Zeitschr. f. Anorg. Chemie, Vol. 37, No. 3, were made with a view of ascertaining the suitability of selenium cells for spectrophotometric purposes and of elucidating the process occurring in the cell. A large number of cells of properties as widely different as possible was examined, the selenium used being derived from six different sources, and the cells constructed according to two different methods. As regards the behavior of selenium with respect to light, permanent and temporary influences should be considered separately. The question as to the kind of light selenium is most sensitive to, has been answered by Sale (Pogg. Annal. 150, 333) by stating that selenium is most sensitive to the rays of the extreme red, this sensitiveness decreasing continually from the red through orange, yellow, green, and blue toward violet, and disappearing entirely for actinic rays. As shown by the author, this statement does not, however, correspond perfectly with the phenomena observed, the latter being really much more complicated than would correspond to this simple rule. In fact, the relative sensitiveness with regard to the various colors is different for different temperatures; moreover, the resistance of the cell, as well as its relative sensitiveness to different kinds of light, is found to vary with the voltage, or what is probably more correct, with the current intensity. In by far the greater part of the cells tested, the sensitiveness to red is, however, found to be higher than the sensitiveness to blue rays. The sensitiveness of selenium to red light is, by the way, strongly modified by a previous intense illumination with white light or else by a permanent blue illumination. These phenomena are analogous to the phenomenon observed by Becquerel in connection with phosphorescence of bismuth compounds, as well as with the action of colored light on a silver electrode coated with silver chloride.

In the second part of this paper, the influence of temperature on selenium, which is known to be of quite an extraordinary magnitude, is more closely studied. According as selenium on being heated either increases or diminishes its resistance, non-metallic or "soft" selenium should be distinguished from metallic or "hard" selenium. The former modification is found to take ever-increasing conductivities up to 217 deg. C., when the needle of the galvanometer, after some latent heat has been absorbed, will return suddenly to the deflection corresponding with the temperature of 20 deg. Now, if such selenium be cooled in the dark, the resistance after increasing rapidly for some time, will be lowered from +8 deg. at ever-increasing rates, the selenium approaching in every respect the behavior of the other modification. The latter (metallic or hard) modification is generally distinguished by a better conductivity and a much lower sensitiveness to light than non-metallic selenium. On being cooled, the resistance is found to fall at first extremely rapidly, the rate becoming slower at lower temperatures. On being heated, the resistance of a similar cell will at first be increased, to fall again from about 70 deg., when the cell distinctly assumes the properties of the other modification. From the above it is inferred that the metallic modification will, even at ordinary temperatures, though at extremely slow rates (often requiring years) be converted into the other form of selenium, this conversion being accelerated by white and especially by red light, whereas blue light will exert an opposite action.

The "inertia" selenium is next dealt with, the following results being derived in this respect: Though selenium does not exhibit any inertia proper, the action

of light is far from being confined to the surface and to the illuminated portion of the cell, as mostly supposed, being transmitted all over the cells and penetrating even to a certain depth. Special selenium cells in the case of their being uniformly illuminated did not show any inertia, reacting instantaneously on any modification in the light they are struck by. The resistance of all the cells investigated, after reaching a minimum on being illuminated, would begin increasing again with continued illuminations in order to become constant after some time.

As regards the cause to which the photoelectric properties of selenium should be attributed, the author is opposed to Bidwell's opinion, according to which these would be due to metallic impurities contained in the selenium. Mr. Marc purposes continuing these researches and publishing any further observations in due course.—A. G.

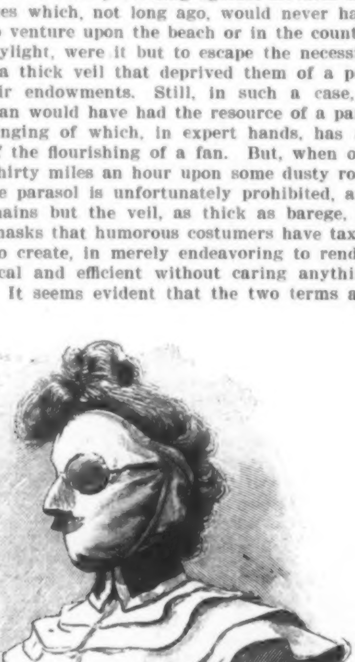
NEW STYLES FOR WOMEN AUTOMOBILISTS.

THE fantasticalness, the hideousness even, of certain costumes or of the accessories of costumes that have been devised for the use of female chauffeurs must forever have restrained all pretty women from indulging in the sport of automobilism, were anything capable of discouraging a woman when it is a question of tasting a pleasure or merely following a fashion.

To conceal or to disguise a figure that is often a fine one in the loose folds of an ugly duster, to con-

THE VEIL WITH GOGGLES.

fine one's self in heavy and vulgar furs and sometimes even to risk a stiff and malodorous leather cloak, all that is nothing. But notice what contrivances have been manufactured for protecting against freckles and sunburn faces which, not long ago, would never have consented to venture upon the beach or in the country in broad daylight, were it but to escape the necessity of wearing a thick veil that deprived them of a portion of their endowments. Still, in such a case, a stylish woman would have had the resource of a parasol, the swinging of which, in expert hands, has all the grace of the flourishing of a fan. But, when one is making thirty miles an hour upon some dusty road or other, the parasol is unfortunately prohibited, and nothing remains but the veil, as thick as barege, or the varied masks that humorous costumers have taxed their wits to create, in merely endeavoring to render them practical and efficient without caring anything for beauty. It seems evident that the two terms are



ONE OF THE PRETTIEST WOMEN OF PARIS.

irreconcilable, since, with rare exceptions, inventors have discarded oddness only to adopt ugliness. One of them devises a sort of armor of cloth, a genuine half-mask, in which the eyes are covered with huge convex goggles, while a hood envelops the head and protects the hair against dust. Another, preserving the glasses, covers the entire face with cloth, leaving at the base of the nose a wide aperture that gives the patient, so to speak, the head of some sort of fantastic bird, a cross between the parrot and the

THE HALF-MASK WITH HOOD.

harpy. Another, with a view to doing better, has endeavored to give the mask, with which he covers the entire face, the appearance of life by modeling and enameling it, but without succeeding in lessening the painful and irritating impression that a face thus disguised always gives. Still another, in an effort toward elegance, has simply set into a lace veil the huge goggles of a Chinese scholar that had been adopted by his competitors.

A number of female devotees of automobilism, however, scorning such complicated and barbarous devices, are content to fasten around their caps a tastefully ruffled veil of more or less opacity. The face is thus entirely concealed, but is neither deformed nor rendered grotesque, and is perfectly protected against the elements.

If we are to believe the English journals, the female chauffeurs of the other side of the Channel have an aversion to such extreme measures, and are loth to consent to mask their features and disfigure themselves in this manner, but stick to the veil and leave the physiognomy quite apparent. Evil-minded persons, smiling ironically, will doubtless be led to recall a bit of dialogue between an Englishman and a Frenchman (two diplomats, we believe) at the moment of the signature, by Napoleon, of a treaty of peace in which he claimed quite a heavy pecuniary indemnity.

"You people are very astonishing," said the Englishman, "thus to exact money for the cost of a war. For

THE FALSE-FACE.

our own part, we are content to fight for glory simply."

"What would you have, my lord?" said the other banterer. "People always fight for what they have not got!"

It is to be believed, that in the case that occupies us, our sporting women are so sure of their superiority as regards elegance, and so confident of their charms, that they do not hesitate to sacrifice a portion of them in exchange for a great pleasure, being uniformly preoccupied with the delight that they find in driving upon the highways, at full speed, and not with the effect to be produced upon passersby.

In order to obtain an idea of the infatuation possessed at present by the sports that permit the poor sedentary citizen, made a prisoner by his occupation, to enjoy at one time and another, on Sundays and holidays, the open air, the country, and free space, as well as to obtain an idea of the popularity of the higher class of amusements, there is nothing better than a halt of an hour or two, on the evening of a fine vacation day, at the Suresnes bridge, the confluence of a certain number of roads that lead to famous excursion points. Here there is an astonishing, a bewildering pell-mell of bicycles and automobiles passing in a torrent before the amazed eyes of the pedestrians, who have prudently taken refuge upon the sidewalks; a compact torrent that the police, club in hand, do not always succeed in mastering; a swift current in which are compounded the most diverse elements—correct bicyclists upon their machines of the latest type returning from some very select pleasure party, more modest cyclists plainly equipped, and luxurious automobiles kept at a slow speed in the crowd and trembling like racehorses that are held in check, but that the vertiginous race has not wearied.

And the beautiful lady chauffeurs, with blood in the cheeks behind the thick veil or the somewhat carnivalesque mask, recapitulating the sensations of the recently finished excursion, are doubtless saying to each other that, all things considered, the pleasure of annihilating space and of going at full speed in accordance with one's fancy and caprice, is well worth one's resigning herself to a seeming ugly—or at least questionable—appearance for a few hours.—Translated from L'Illustration for the SCIENTIFIC AMERICAN SUPPLEMENT.

RECENT STUDIES OF RADIUM AND RADIO-ACTIVITY.

J. HÄRDIN, in Phys. Zeitschr., states that crystals of uranium nitrate shaken in a glass tube give off a yellowish-green shimmering light. In a tube containing air at ordinary pressures, they enable the air to act like the rarefied gas in a Geissler tube; but the light produced has no photographic and no fluorescence-exciting power when a dark card intervenes. An ordinary induction coil brings out this effect better than a Tesla coil. A magnetic field does not induce luminescence.

W. Kaufmann, in Ann. d. Physik, refers to Geigel's

THE MOST STYLISH ARRANGEMENT.

paper on the absorption of gravitational energy by radio-active bodies. The same results can be obtained whether there is or is not any radium in the dish under the mass of lead, provided the dish has been put in place with the fingers; the effect therefore seems thermal and due to feeble ascending currents of warmed air. In the absence of this cause, radium chloride produces no effect beyond the limits of experimental error (equally + and —, 0.0005 mg. on 10 grammes). Geigel's alleged dependence of the effect upon the breadth of the radio-active material is explicable as depending on the breadth of the ascending air-current.

G. C. Schmidt, in Ann. d. Physik, refers to his former account of experiments on the emanations from phosphorus and describes extended observations from which he deduces the following conclusions: For the appearance of ions or electrons in the case of the slow oxidation of phosphorus, no example has hitherto been brought forward. The conductivity arising through the oxidation of phosphorus is only an apparent one, which is caused by the convection of electricity by means of solid fog-like conducting products of oxidation. The conducting particles are the phosphorus acids.

A. Debierne, the discoverer of actinium, considers in Comptes Rendus the behavior of actinium. He notes that the action takes place as if the activation was produced by a peculiar radiation sent out by each of the centers of energy (emanation), the activation of a layer placed in an inclosure with actinium being proportional to the total flux of radiation that it absorbs. Debierne's experiments appear to indicate that there exists a new radiation characterized essentially by the property of temporarily rendering radio-active the bodies on which it strikes. This "activating radiation" proceeds from activating centers within the gas in the neighborhood of the actinium. The new rays can be deviated by a magnetic field and by an electric field, the deviation being such as would occur in the case of positively charged particles animated with a high velocity.

In the Phil. Mag. E. Rutherford and F. Soddy give a comparative study of the radio-active properties of thorium and radium. These properties are closely allied, though there is a great difference in their relative activity. The occlusion of the emanations is considered, and the influence of the emanation on the radio-activity of radium. The rate of decay of radium emanations and the recovery of radium activity are expressed by means of curves. Radium, like thorium and uranium, emits two types of radiation, the α, easily absorbed, and only deflectible in very intense magnetic fields, and the β, or penetrating rays, readily deviated in a magnetic field. It also emits some very penetrating rays not yet fully investigated. The X-rays are the first to be produced, the β-rays only resulting in the last stages of the process that can be experimentally traced.

The influence of radium on the growth of embryos is studied by G. Bohn in Comptes Rendus. Embryos of toads and frogs are exposed to the radiations from radium bromide for from three to six hours. The growth of toad embryos, which is normally slow, is inhibited. Frog embryos eight days old rapidly change into tadpoles, but become deformed in various ways. Younger individuals at first appear uninfluenced by the rays, but when they develop into tadpoles, they show similar deformities. A few of the embryos die almost immediately after this treatment.

R. J. Strutt, in Nature, points out the importance of determining whether radium, as contained in pitchblende, emits as much energy as the same amount of the material in the form of an artificially concentrated product. The mineral has probably been liberating energy at not less than its present rate for a period of time comparable with the age of the earth. The author estimates that at the center of an infinite slab of pitchblende one meter thick, the temperature would exceed that at the faces by about a fifth of a degree, so that the effect could probably be measured experimentally.

Recent experiments have confirmed the conclusion that freshly made thorium preparations are strongly radio-active to different degrees according to the amount of uranium contained in the mineral. Pure thorium and its compounds possess in themselves no primary activity, inactive thorium earth having been obtained from orthite, yttrotitanite, and gadolinite, the oxide from the latter mineral being unable to affect a photographic plate through thin black paper in twenty-four hours. The gadolinite has the property of suddenly glowing throughout its whole mass on heating.

E. G. Willcock exposed animals of simple structure to radium-rays with a view to determine (*a*) whether the rays would cause an immediate contraction; (*b*) whether they would repel or attract animals bodily. Under (*a*) it was found that actinosphærium, with pseudopodia extended, did not retract its pseudopodia when exposed in daylight to 10 mgm. of radium at 3 mm. distance. In two hours, however, it was dead and breaking up; controls were unchanged. *Stentor* contracted when exposed to radium emanations. Under (*b*) it was shown that *Stentor* and *Hydra* (both viridis and fusca) moved bodily out of the path of β rays; weak specimens were killed. Encysted specimens of *Euglena viridis* become motile under the influence of β and γ rays, and disperse without suffering any harm.

MUSCULAR EXERTION AS AN ELIMINANT OF ALCOHOL IN THE BLOOD.

I HAVE for a long time been studying ethylic alcohol from the standpoint of physiology and hygiene, and have demonstrated by experiment that a measured volume of this liquid, introduced into the stomach of an animal by means of an œsophageal canula, passed into the blood, wherein I have examined its proportions for several hours in succession by means of the very exact and ingenious bichromate of potash process devised by my pupil and preparator, Dr. Nicloux, in 1896.

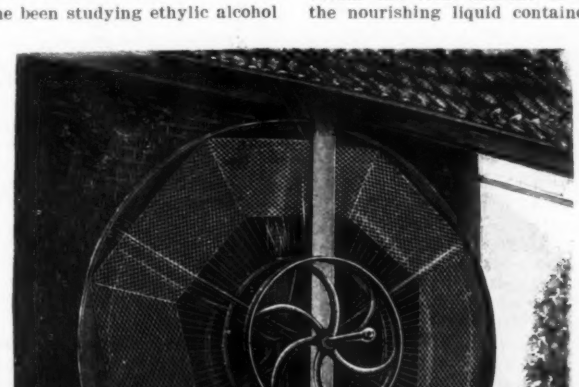
A very large number of quantitative analyses have permitted me to construct curves that show that, in the hours following its introduction into the stomach, the proportion of alcohol remains absolutely fixed and there forms a Grehaut "plateau." All the symptoms, acute or chronic, produced by ethylic alcohol in the animal organism, are due to the existence of this plateau, which represents a constant proportion of alcohol in the blood that afterward diminishes at the end of 6 or 7 hours or a longer time, the curve not reaching the time of the abscisses until after 21 or 23 hours. If the alcohol burns in the organism, its combustion is slow and requires much time.

I cannot just now summarize my researches, but I wish to point out to my readers a fact of which the demonstration has been begun by me and which, I hope, will give rise in the future to a large number of comparative researches of great interest. It is a question of knowing within what limits muscular exercise favors the disappearance of alcohol from the blood that it has entered, by stomach absorption, pulmonary inhalation, or by direct injection into the blood-vessels.

I have very recently made known to the Society of Biology the results that I have obtained by a dog-power wheel similar to that employed before me by Prof. Chauveau and Profs. Laveran and Regnard, my learned colleagues of the society.

The accompanying figure represents this wheel, which is about ten feet in diameter, and which I have installed against a wall outside of my laboratory and under a roof. Any dog, introduced in the wheel begins to revolve it without hesitation at the first trial, and can continue to make from 10 to 20 revolutions, according to his gait. Ten revolutions correspond in one hour to a travel of 3.3 miles.

At 8 o'clock in the morning I inject into the stomach of a dog 0.675 fluid ounce of alcohol to 5 per cent per pound of its weight. Five hours afterward I introduce into the jugular vein in the left side a fine canula and suck 0.5 fluid ounce of blood and inject it into my distilling apparatus in a vacuum. In a few minutes I obtain the total amount of alcohol and water that the nourishing liquid contained.



WHEEL FOR DEMONSTRATING THE INFLUENCE OF MUSCULAR EXERTION UPON THE ELIMINATION OF ALCOHOL FROM THE BLOOD.

The quantitative analysis of the alcohol is made with a solution of bichromate of potash of a strength of 285 grains to the quart, which is such that if 0.17 fluid ounce of liquid containing 1-1000 part of alcohol be heated in a test tube with 0.035 fluid ounce of the bichromate solution, after adding some sulphuric acid, there will be obtained a bluish-green color, while 0.17 fluid ounce of alcoholic liquid heated with 0.034 of bichromate will give a slightly yellow solution that will indicate in the reaction the limit discovered by Nicloux.

Three samples of blood are taken from the dog at 3, 6, and 7 hours after the stomachal injection. We find from the curve that a descending straight line has been obtained. Then the animal is introduced into the wheel and made to revolve it for an hour without interruption. New quantitative analyses of alcohol show that the line becomes broken and makes an angle of 14 deg. with the primitive direction. In the following hour of rest, the curve indicates a more feeble elimination of alcohol.

It is therefore certain that muscular exercise favors the elimination of alcohol from the blood, and it ought therefore to be recommended to those who have introduced into their organism a quantity of alcohol less than that which produces intoxication and renders walking impossible. In the latter case, I think that motion communicated in the open air, in a carriage for example, might be useful; but it would be necessary to demonstrate it experimentally.—N. Grehaut. Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

THE KERN BURNER AND THE CLAMOND STOVE.

THE KERN BURNER.

THE Kern burner is a new modification of the Bunsen type, constructed with a view to effecting a thorough mixture of the air and gas, and at the same time of directing the stream evenly and directly upon the surface to be raised to incandescence.

Our illustration shows the different parts of this burner. It consists of the usual gas jet, mounted in a nut which screws into the lower end of a tube narrowing toward the center and widening at the ends. The shape of this tube, more precisely, is a hyperboloid of revolution. At the base, near the gas jet, are four windows to admit air. The gaseous mixture passes up the tube, arriving at the top under a perforated cone, where a more thorough mixing takes place; it then enters a chamber above the cone, whence it issues through a grating, passes over a double cone, and ultimately leaves the burner by escaping between the beveled teeth of a horizontal wheel, being by this device directed toward the flame in a regular cylindrical stream. The gaseous mixture, in passing through the perforated cone, becomes heated, and is already at a fairly high temperature when it reaches the flame.

The flame is very suitable for use with Welsbach mantles. In that case a rod of magnesia is fixed at the top of the burner to support the mantle in the usual way.

Several different models of the burner have been constructed on this plan for consumption varying between 14 and 200 liters per day (½ to 7 cubic feet). According to the pressure, the quality of the gas, and the nature of the mantle, the consumption per candle hour is 1 to 1½ liters of gas (1-30 to 1-20 cubic foot).

The Kern burner has also been used by Mr. Clamond for heating purposes. In our illustration a stove constructed on this principle is shown. The mixed gases pass into a little reservoir, in which is placed a perforated cylinder similar to the cone of the Kern burner. From this chamber the gases, now thoroughly mixed, are distributed to a series of perforated cylinders of fire clay, where the mixture issues from the meshes and burns, raising the fire clay to incandescence. An intense heat is thus obtained; the products of combustion are led off to a flue in the ordinary way.

The working of these burners has been carefully investigated by M. A. Leconte. An analysis of the products of combustion shows that they consist entirely of carbon dioxide and water vapor, without any trace of carbon monoxide, for which careful tests were made. Besides offering this advantage of giving rise to no noxious products, the Clamond stove has a very constant action and is very economical.

American Farm Implements in Austria.—American farm machinery does not find a ready sale here. Cheap labor, small farms, and the stony and hilly character of the land render the employment of machinery unprofitable, and sometimes impossible. But I am satisfied that many of our farm and garden tools could be successfully introduced if systematic efforts were made

by our manufacturers to bring them to the general attention of Austrian farmers and gardeners. Dealers will not, as a rule, import an article unless a demand for it has first been created.—Frederick W. Hossfeld, Consul, Trieste, Austria.

SCIENCE NOTES.

A. Claret finds that the addition of borax, in the proportion of 2 parts to every part of iodine used, is a good means for preventing the formation of hydriodic acid in alcoholic solutions of iodine such as the Codex tincture (and the B. P. Liquor Iodi Fortis), and also for removing that acid when it has been formed in long-made preparations. The avoidance of this free acid is of importance, since severe pain and burning, followed by desquamation and excoriation, may be provoked by the application of a very acid iodine liniment.—Journ. Pharm. Chim.

The chemical reactions concerned in the process of rusting may be represented by the following equations:

$$Fe + O_2 + H_2O = FeO + H_2O_2.$$
$$2\,FeO + H_2O_2 = Fe_2O_2(OH)_2,$$

the latter representing the composition of iron rust. Water in the liquid state is essential alike for the occurrence of rusting and for the formation of hydrogen peroxide. In the case of certain metals, notably that of zinc, hydrogen peroxide can be detected during the process of rusting. It has not been possible, however, to detect with certainty the presence of hydrogen peroxide during the rusting of iron. This may be due to the fact, previously mentioned, that iron is very rapidly oxidized by hydrogen peroxide with formation of rust, so that under ordinary conditions the hydrogen peroxide is quickly destroyed. Other conclusions are that the direct decomposition of water by metallic iron with liberation of hydrogen can take place only at a relatively high temperature and is not affected by the presence of alkaline salts, such as sodium carbonate. The action of aqueous carbonic acid on iron in the absence of oxygen results in the liberation of hydrogen and formation of ferrous carbonate or bicarbonate. If oxygen is present, the ferrous salt subsequently undergoes oxidation, the rust obtained in this case containing a varying amount of carbonate. Electrolytic action occurs when the iron is impure or when another metal is present. The electro-positive metal suffers oxidation and hydrogen gas is evolved. This action is not prevented by the presence of sodium carbonate.—Proc. Chem. Soc.

Small pieces of highly purified sheet iron were inclosed with the different solutions in sealed glass tubes, the space above the solution in each case being filled with pure oxygen. The following substances were found to prevent to a greater or less extent the formation of rust: sodium carbonate, ammonium carbonate, borax, disodium hydrogen phosphate, calcium hydroxide, ammonia, potassium dichromate, potassium ferrocyanide, chromic acid, sodium nitrite, and potassium carbonate. Rusting occurred in the presence of the following compounds: sodium chloride, potassium chlorate, ferrous sulphate, potassium ferricyanide, potassium nitrate, and sodium sulphate. The reagents which prevent the rusting of iron are those in presence of which decomposition of hydrogen peroxide takes place and which are consequently inimical to its formation. There can be little doubt, therefore, that hydrogen peroxide plays an important part in the chemical process of rusting. By the direct action of hydrogen peroxide on metallic iron, a red basic ferric hydroxide, identical with ordinary rust, is rapidly produced, and it is found that in general those metals rust in air which are oxidized by hydrogen peroxide, while those metals which are not oxidized by hydrogen peroxide do not rust in air. Iron, zinc, and lead are examples of the first class, and the rusting of all these metals is stopped by contact with substances which prevent the formation of hydrogen peroxide. Copper, silver, and nickel are examples of the second class; these metals do not rust in air and are not oxidized by hydrogen peroxide.—Proc. Chem. Soc.

Beuttner has compared several methods for the assay of cinchona bark, especially that of the German Pharmacopœia and that of Keller. Both of these methods yielded discordant results, which were generally lower in proportion as the length of time occupied by the extraction of the alkaloid was prolonged. Here also Beuttner eventually found that part of the alkaloids were deposited in a minutely crystalline form from their solution either in ether or a mixture of ether and chloroform, and the following method of treatment was devised to obviate this inconvenience: 7 grammes of finely powdered cinchona bark are weighed into a 200 cubic centimeter medicine bottle, 55 grammes of chloroform added, and then 5 grammes of a 10 per cent solution of caustic soda; the mixture is well shaken for three hours. 85 grammes of ether are added, and, after well shaking, 3 grammes of powdered tragacanth and sufficient water (10 to 20 grammes) to make the bark agglomerate. The ether-chloroform solution is then immediately poured off and shaken with 2 grammes of water and 1 drop of solution of soda. 3 grammes of tragacanth are now added, and after well shaking, 100 grammes of the ether-chloroform solution, which is now perfectly bright, is filtered through cotton wool into a separator. 15 cubic centimeters of N/10 hydrochloric acid and 5 cubic centimeters of water are run in and shaken, the acid solution separated, and the ether-chloroform washed with water. The acid liquid is then titrated with N/10 solution of soda, hematoxylin being used as the indicator.—Schweiz. Woch.

ENGINEERING NOTES.

"**A German experimenter** Herr Bernhard, noting the structure of aluminium," says The Engineer, "decided to try it for putting an edge on fine-cutting instruments, such as surgical knives, razors, etc. He found that it acted exactly like a razor-hone of the finest quality. Further investigation showed that when steel is rubbed on it the aluminium disintegrates, forming a minute powder of a greasy, unctuous nature that clings to steel with great tenacity, and thus assists in cutting away the surface of the harder metal. So fine is the edge produced that it can not be made finer by the strop, which, used in the ordinary way, merely tends to round the edge." In quoting the above statement the American Machinist says that an aluminium hone tried recently by an engineer who had read a similar item of news was not at all satisfactory. It remarks: "If the German experimenter named made a success of it, perhaps there is some important detail left out. Does he use oil, water, or other lubricant?"

A remarkable piece of engineering was completed recently in Cranston, R. I. The chimney of the Narragansett Brewery, 192 feet in height, owing to undermining by water, was so badly out of plumb (leaning nearly 4 feet toward the east) that its falling seemed assured. The fate of an $8,000 chimney seemed to be imminent and certain. J. H. Gerhard, civil engineer, of Cranston, R. I., undertook to straighten this rival of the leaning tower of Pisa. The plan devised by Mr. Gerhard was a simple one. One course of bricks three-quarters of the way through the chimney was removed from the west side, and its place was taken by wedges of oak. An 8-foot bed of concrete was then laid against the foundation on the east side. Two holes were cut in the east side of the chimney, and in these were inserted 22-inch steel beams 25 feet in length. These were used as levers to tip the 192-foot chimney toward the west. The wooden wedges were gradually burned out by a gas flame driven into the oak by compressed air. The chimney, as the wood was burned away, gradually approached the perpendicular line, the movement averaging about 6 inches a day. When the chimney was straight, the space occupied by the brick was filled and the steel beams were buried in concrete after the removal of the jack screws. This has obviated the necessity of moving the boiler house to another location.

Elisha Gray's electro-mechanical governor is described in the Western Electrician. In this governor an equilibrium valve is moved by two cores which are mounted on opposite sides of a pivoted lever connected to the valve-spindle. These cores respectively extend into two oppositely-arranged solenoids, so that one acts to open the valve and the other to close it. The circuits of these solenoids are connected in parallel to one terminal of a battery, one or other of the circuits being completed, as required, by the following centrifugal device: On a part rotated by the engine at a high rate of speed is mounted a box having an annular concentric space in which is pivotally mounted a circumferentially extending contact-lever connected to the other terminal of the battery above mentioned, and acted upon by a spring tending to draw it toward the axis of the box. The free end of this lever plays between two contacts connected respectively to the ends of the two solenoid circuits. By this means, when the engine is running at its normal speed, the contact lever floats between the contacts, but when the speed varies the contact-lever touches one or other contact, accordingly as the centrifugal force or that of the spring is the greater, and the valve is moved to correspond. In operation, the contact-lever is in more or less continuous vibration. A modification is described in which the centrifugal device is combined with an ordinary ball-governor acting as an auxiliary on the contact-lever.

This story is told of the firm of Smith & Porter, which later became the well-known H. K. Porter Company. The original firm in 1868 built a locomotive for a small railroad running out of Greenup, Ky. This town is 333 miles below Pittsburg, Pa., on the Ohio River, and at about the time the delivery was to be made none of the towboats appear to have been available, the river being very low owing to a long drought, and other transportation facilities were not to be had. It was, however, decided by Smith & Porter that the engine should be delivered at the specified time. Mr. Smith obtained a suitable flatboat, and placed the machine aboard, and with the help of several men the locomotive was arranged to propel the boat. The main driving wheels were at the rear, and the side-rod extended forward, as in many of our modern 4-4-2 engines. The front ends of the side-rods were uncoupled and the rods thrown back so that they extended out behind the engine as far as the leading wheels were ahead of the main drivers. The projecting ends of the side-rods were coupled to a temporary crank shaft, arranged for the purpose, and on the ends of this shaft were two paddle-wheels. The main drivers were jacked clear of the rail and the boiler was fired up. In action the locomotive presented a strange appearance, standing on the deck of a scow, its leading drivers hanging motionless, its main driver slowly turning and its reversed side-rode working a crank shaft which made a pair of dripping paddles revolve, while the engine solemnly puffed its way down stream. This novel locomotive-steamboat made the voyage successfully, and furnishes a good example of what men of enterprise could do to overcome difficulties thirty-five years ago.—Railway and Locomotive Engineering.

ELECTRICAL NOTES.

A Calcutta correspondent of the London Electrician says that an installation of Jablochkoff candles at Calcutta has just been superseded by inclosed arc lamps after more than 22 years of service. The installation was put down some time in 1880 or 1881 to light the grounds of the Eden Gardens and gave admirable service up to November 14 of last year, when a modern plant was put in. The original installation consisted of some thirty lamps, the wiring being carried in iron pipes to the engine house close by. After about a year the cable developed faults and had to be abandoned, and new cables were laid in teakwood troughs run in solid with pitch. To this day they are still good. There is no telling how long the old arrangements might have been adhered to had not one of the boilers been finally condemned by the inspector. There are a few more lamps of the same era still working in Bengal.

Among the many industries congregated around the districts of the rivers Tyne, Wear, and Tees, there are none which have made such rapid strides in the last few years in the application of electric power as that of shipbuilding. It is safe to say that in 1894 there was not an electric motor at work in any of the shipyards in the district for the purpose of driving the tools in shipbuilding, and possibly beyond a few motors used for cranes, and dynamos for lighting, there was not any electrical apparatus in regular use. In 1904 the situation is entirely reversed, and with very few exceptions, there is not a single shipyard which does not derive either the whole or a very considerable portion of its power from electricity. It is difficult to give any comparative figures as to the relative costs of the old steam power and the newer electric installations, owing principally to the fact that as soon as shipbuilders realized the great advantages which electricity gave them to increase their output they added machines as fast as it was possible to put them down to carry on and extend their business. From figures supplied by a shipbuilding firm who adopted electric driving in its early stages, it is possible to give a comparison of the cost of power per "pound of wages paid" in the years 1894 and 1901, that is to say, before and after the use of electricity. The figures are as follows: In 1894 the cost for coal, gas and labor for driving the engines scattered round the yard was 8.66 pence per "pound of wages paid," and in 1901 the cost for coal, labor, and other incidentals for producing the power electrically was 4.88 pence per "pound of wages paid," or, in other words, the wages paid in 1901 were practically double those paid in 1894, and the cost for power was the same, and this in spite of a very great increase in the number and size of the machine tools employed, which, in the yard in question, practically amounted in 1901 to six times what were in use in 1894. The cost of producing a Board of Trade unit varies from slightly under a penny to a penny farthing, depending on the load factor, the area of distribution and the size of the plant. These figures of cost include an allowance of 10 per cent. for interest and depreciation on the generating plant and distributing cables.—C. S. Vesey Brown in Cassier's Magazine.

In the Journal of the Chemical, Metallurgical, and Mining Society of South Africa there appears an interesting paper by Mr. E. M. Hamilton recently presented to that society. It deals with the development of the electrolytic process for the precipitation of gold and silver from cyanide solutions, and it is not designed to reopen the old discussion on the respective merits of the electrolytic and zinc methods of precipitation. The author draws attention to improvements in the Siemens & Halske process which have been developed by Messrs. Charles Butters & Co. in Mexico and the United States. With the apparatus in question, the anode used is a lead plate covered with peroxide, and the cathode is of tinplate. The advantage of this over lead foil is that it is practically indestructible. The great point in the process, however, is that the metals in solution are deposited as a slime instead of plating them on to the anode. In order that this may be done the current density used is increased until it is considerably higher than the proper ratio of the metals in solution when required for a reguline deposit. The advantages of the system over the old methods which were originally worked on the Rand are: First, the absence of any action on the anode, thus rendering it permanent, and avoiding by-products formed by its dissolution; second, as a consequence of the foregoing, a very wide latitude in the current density which may be employed, in contrast with the behavior of the iron anode, which rapidly succumbed to the effects of a high current; and third, the permanence of the cathode, which, instead of being melted down every month in order to recover the values deposited, remains in its place the whole time. The deposited slimes are collected at intervals without disturbing the anodes in the depositing troughs. The author concludes that, as regards the usefulness of this method of electrolytic precipitation it is possible that it would not be advantageously applied in the case of a proposition where the metal to be deposited is almost exclusively gold—this could only be found out by trial—but where the values are largely composed of silver (implying a considerable weight of metal to be thrown out of solution) it would seem likely to be very serviceable, and in cases where large quantities of copper are dissolved in company with the gold and silver the method would probably be found exceedingly valuable.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Trade and Enterprise in Guatemala.—Imports from the United States.—The United States is more than holding its own in the race for the imports of this republic, which, it may be said, are generally decreasing, because of the hard times through which the country is passing. Large quantities of groceries, flour, potatoes, shoes, dry goods, and clothing come from the United States, but Germany and England seem to have the lead in machinery and hardware. There is surely a fine opening in these latter lines for our exporters, but they must be in position to push their goods personally, to give longer credits, and to take more pains with packing.

Packing.—This is a very important matter for our exporters to study. Goods must be well packed that there may be as little loss in shipping as possible, and this packing should be as light as possible consistent with the safety of the goods, since the same duty is charged per pound on the case or box as is charged on the contents. So it is plain to be seen that the lightest of woods should be used, and instead of using too heavy or thick boards more band iron to strengthen the corners and edges should be used.

The European shipper has the packing question down to a finer point than the American shipper, but I am glad to say the American is improving, and with more study and care will win. It is one of the principal things to overcome in our conquest of the Central and South American markets.

Tariff.—As emphasizing the necessity for scientific packing, I invite the attention of our exporters to the tariff of this republic, which indirectly often works to an almost prohibitive degree when heavy packing is resorted to.

The duties in this country are either levied on the gross weight or on each article; there is no ad valorem duty. During the past year by a decree of the authorities of Guatemala the rate of duty collected has been increased about 50 per cent. Since most of the duties are collected on gross weight, the question of packing is a big item which the American exporter does not generally take into account, to the detriment of his future business with these people. As said before, everything for this country should be thoroughly packed, but with as light material as possible, and not in too large cases. The English and German importers excel our merchants and manufacturers in this.

Machinery.—Though little machinery is in use in this country, the best of what is in use comes from the United States. This, however, is very largely wood-working machinery, ice machines, iron-working machinery, etc., as most of the farm machinery comes from Europe, strange as this may seem. The reason given for this by the planters is that American machinery and implements are too light for the native workmen. This is but the prejudice, natural enough, of agricultural laborers who have been used to nothing but the crudest implements, and who imagine that lightness and strength cannot be combined. There will be a good opening here for American machinery when better times return, if our manufacturers study the conditions and meet the requirements as to models and weights. I suggest that this is a good time to begin to get ready by sending out a man to study the conditions for all Central America, as the conditions are about the same in all the republics.

American Enterprises.—There is quite a large amount of American capital invested in this republic, and in the main it is earning very good returns, notwithstanding the business depression, for American push wins where others fail.

All the railway interests in this country are American, and much is invested in plantations and other interests—such as mining and lumbering.

In all, it is safe to say, there are $8,000,000 of American capital invested in Guatemala, and there is an opening for much more, if it is backed by the right kind of management.

There is but one street-car line in this republic, and that is in Guatemala City. There are about 7 miles of track laid with 60-pound T-rails. Mules are used for motive power and the service is fair. The fare charged, I think, is the lowest in the world, being 1 real, or about two-thirds of 1 cent in United States gold, for a single trip, with no transfers.—Alfred A. Winslow, Consul-General at Guatemala City, Guatemala.

American vs. European Trade in Cuba.—Referring to the question of competition between American and European houses for the trade of Latin America, I am informed by an intelligent business man of this city that while European houses frequently give longer credits than their American competitors they require a much longer time to fill an order, and that their prices, based on extended credits, are not on the whole as advantageous to the Cuban merchant as the cash prices and short credit system of the Americans.

Speaking with reference to the alleged deficiencies in American methods of packing goods for shipment to the West Indies, this gentleman tells me that although there is yet room for improvement along this line, American goods are almost invariably packed with greater care and received in better condition than those from Germany and other European countries.

I think I am safe in saying that nine-tenths of the merchants and planters of Cuba regard the United States as their logical trading ground, desiring to find there a remunerative market for their leading staples and equally desirous of buying there the manufactured articles and other necessities needed in the development of their country. The Cuban people are hoping and trusting that reciprocal trade relations between the two countries will soon become a reality, thereby giving a stimulus to the present and prospective industries of Cuba, which thus far since the achievement of their political independence has been distinctly lacking. I do not wish to be understood as saying that the island was in a prosperous condition during the later years of Spanish rule, but certain privileges accorded Cuban products while Cuba remained a colony of Spain terminated when the political separation took place, and the people now turn to the United States as their natural coadjutor in their efforts to place the industries of their country upon a firmer and more prosperous basis than they have ever been in the past.—Max J. Baehr, Consul at Cienfuegos, Cuba.

American Products in Bradford.—Shooks.—The importation of American shooks into this district is assuming considerable proportions. Nearly all shippers of textile merchandise have resorted to the use of these cases for forwarding their goods to the United States. The first attempts to introduce them were made in 1892, but it was some time before the full advantage of their use was realized. In 1902 there were 6,918 cases imported, while during the first nine months of the present year there have been 18,893.

Automobiles.—Notwithstanding the strenuous endeavors of the English, French, and German manufacturers to obtain the supremacy of the market, it is pleasing to note that American automobiles can be seen running about this district. This part of the country is very hilly, and light knockabout cars of 5 horse power, which, owing to their reasonable price, have found favor, are well spoken of and give satisfaction.

Furniture.—The demand for American furniture has been as great as ever, but, unfortunately, the import houses have not been able to get their orders executed promptly. They still complain of the apathy of our manufacturers in endeavoring to meet the English taste, and assert that were this done a much larger volume of business could be transacted.

Hardware.—In the hardware trade our productions continue to make headway. There is a growing demand for labor-saving devices, and goods which are well made have a ready sale.

Provisions.—In provisions there has been a fair sale of American goods, though in regard to hog products a greater run than heretofore has been made on imports from Canada, owing to the increased prices asked for those from the United States.

In general, there has been an increased demand for American goods, and enterprising exporters have been successful in establishing a market for their commodities.—Erastus S. Day, Consul at Bradford, England.

How to Build Up Trade in Mexico.—When Not to Come to Mexico.—The rainy season begins the first part of July and continues until the middle or latter part of October, and anybody desiring to visit Mexico for either pleasure or business should be warned against coming here during that time. Good roads and bridges being almost unknown on the west coast of Mexico, it is almost impossible to travel in the interior without exposing one's self to great danger and even risk of life. This also holds good as a warning not to send sailing vessels here during this time, as the weather is very uncertain, and all the storms with which this coast is afflicted during the year reach here within the above mentioned period, and during the past months there have been five sailing vessels lost in Mazatlan and its neighboring ports.

How to Increase American Trade.—The imports of Mexico will this year reach $60,000,000 gold. So far as the west coast of Mexico is concerned the greater portion of its trade is with Germany, Spain, and France, in the order named. Business here can only be secured on an established acquaintance. The Mexican merchant, as a rule, will not be rushed into buying goods, but when he becomes personally acquainted with the salesman and feels at home with him it is a very easy task to secure orders. It is not difficult to get acquainted with the Mexican people. They are easy of approach and also easy to get on good terms with, but their temperament prevents them from making contracts in a hurry. A firm that has gained the confidence of a Mexican merchant and has secured a share of his business will never think of rushing the decision while the deal is being considered.

If the deal on hand is a very large and important one, it takes sometimes months before it is concluded, and it would be useless for any one to try to rush things. It is very essential for the agent to speak Spanish fluently, so as to be able to converse with the Mexicans in their native tongue, as very few Mexicans speak English, and while many of the larger houses employ English correspondents in offices, yet many of these same correspondents are not able to converse in English or speak it very indifferently.

One of the great advantages in selling goods to Mexico is that failures are almost unknown here, as the merchants of Mexico are very conservative and extend their business only as far as their capital will permit. Fires and their results, which ruin thousands of business men annually in the United States, are of very rare occurrence here. Mazatlan has not been afflicted with a fire for over thirty years.

The Mexicans are polite to a high degree, and the Mexican merchant carries this characteristic trait into his business transactions. I have recently heard it said that American manufacturers are too curt in their letters; that they abbreviate their expressions and say what they have to say in a line or two, whereas they might just as well take double that space and say it more fully and much more agreeably. There is such a thing as lack of business courtesy even in correspondence.

Much trade could be gained by the exporter or manufacturer familiarizing himself with the conditions existing in foreign countries. Send the best salesmen here.

In my opinion this is the very best way to gain and increase our trade.

The present consumption of many lines of American manufacturers is but a small per cent of the business that should and can be built up by good salesmen on the ground. The Mexican market—that is, the trade condition which prevails in and governs that market—gives preference to the products of the countries which have personal representatives on the ground to explain and exploit the value of the goods which they expect the merchants to buy.

The traffic between Germany and Mexico has increased to such an extent within the last few months that the German line of steamers now plying between these countries is insufficient to handle the export and import business. Owing to these circumstances, it is contemplated to establish a new line of steamers, making direct trips between Hamburg, Germany, and the Mexican ports.

The German press is well posted on the progress and resources of this republic, and points out the fact that Mexico is very favorably inclined toward immigration, and is loud in its praises of the close commercial relations between Germany and Mexico.—Louis Kaiser, Consul at Mazatlan, Mexico.

Americans and English in Southern Brazil.—Export, a German publication, organ of the Central Commercial and Geographical Union, in its issue of October 8, 1903, says:

"The Americans and the English are both endeavoring to exploit Brazil and all of South America commercially and industrially. The United States is seeking fields for her products, and already there is a demand for her agricultural machinery and other manufactures. A direct steamship service has been inaugurated between the United States and the Rio Grande do Sul, with monthly sailings. American promoters have already secured by purchase a concession for building a road in Santa Catharina, while the concession for the Torres-Porto Alegre line is still under discussion by the government. The Americans carry on their negotiations through agents in order to secure as many favors as possible before they disclose their plans. The English, also, are investing capital in Brazil; an example of this is the Brazilian Cold Storage and Development Company, which does a business in exporting meat."

Market for Toilet Soaps in China.—A French consular report from Shanghai states that a large demand exists there for cheap toilet soaps. French, German, and some Austrian firms have secured a good market for such goods by a close study of the Chinese taste. The soaps are wrapped up and labeled in French, as, for instance, "Savons à la Rose de Chine," "Reine des fleurs," etc. The only competitors of the French, German, and Austrian manufacturers worth mentioning are Colgate & Co. and an English house.—Richard Guenther, Consul-General, Frankfort, Germany.

American and Canadian Cheese in England.—The importations of American cheese continue to decrease. Canada has more than ever become the principal source of supply of cheese for the English market, and on the average the quality is considered better than that put up in the United States, and at present the price has been rather lower.—James Boyle, Consul, Liverpool, England.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 1883. February 23.—Proposed Fund to Develop Study of Cotton Supply Abroad—Japanese Direct Foreign Trade—*Faulty American Packing for China—* Pumps and Lamps Needed in China—Notes from Siberia—German Postal and Telegraph Service—Cuban vs. European Sugar—Railway Construction in Canada—Business in British Columbia—Lack of Uniform Fruit Inspection in Germany—Loan for Refunding Debt of Rio de Janeiro—Limitation of Electric Voltage—Report of the Ussuri Railroad for 1901—Russian Railroad Report for 1901.

No. 1884. February 24. La Rochelle and American Trade—Economic Condition of France—French Wood Trade—Tobacco in France—*American Machinery in Syria—* United States-China Parcel Post—Chinese Wood Oil—* Increased Interest in American Topics in Germany—Fire Relieves Taxes—Paris to Peking—Russian Savings Banks—Berlin Incomes.

No. 1885. February 25.—*American Trade in Asiatic Turkey—*Openings for American Goods in Hungary—* Proposed Hungarian Bazaar—*American and German Trade Competition—Railway Construction in Peru—Population and Resources of Brazil—Trade in Peru and Bolivia—Proposed Rental of Parana Railway in Brazil—Prussian Crops in 1903—Commercial Cities of the German Empire—Caution to Exporters of Cement to Turkey—Life Insurance by the Russian Government—Customs Business at Prescott, Canada—Prestations in Congo Free State—Russian Revenues—International Prevention of Epidemics—Notice of Defects—Harbor Cranes for Fiume.

No. 1886. February 26.—Concessions in Mexico—*American Barber Supplies in Austria—* United States as a Consumer of European Products—Area and Population of Canada—Dairying in Mexico—Interoceanic Railway of Honduras—Cotton Goods in Lourenzo Marquez—Opportunities to Sell Dried Fruits—New Process for Obtaining Zinc White—New Alloy—Grain Crop of Bohemia—Origin of Cotton Sewing Thread—No Radium for Sale—Hungary's Shipping Interests—American Fruit in Germany.

No. 1887. February 27.—Financial Stringency in British Columbia—North Sea Canal—Merchant Marine of the World in 1903—Safety of Railway Trains—Commercial Agents and Consuls—Railway Concessions and Construction in China—Prussian Savings Banks—New Coal Beds of Belgium.

* Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

TRADE NOTES AND RECIPES.

To Put a Brown Color on Brass.—Proceed as follows: In 1,000 parts of rain or distilled water dissolve 5 parts each of verdigris (copper acetate) and ammonium chloride. Let the solution stand 4 hours, then add 1,500 parts of water. Remove the brass that is to be browned from its attachment to the fixtures and make the surface to be colored perfectly bright and smooth and free from grease. Place it over a charcoal fire and heat it until it "sizzes" when touched with the dampened finger. The solution above given is then applied—painted over the surface with a brush or swabbed on with a rag. If one swabbing does not produce a sufficient depth of color, repeat the heating and the application of the liquid until a fine durable brown is produced. For doorplates, knobs, and ornamental fixtures generally, this is one of the handsomest as well as the most durable surfaces, and is easily applied.—Nat. Druggist.

Laundry Bluing.—To make a first-class laundry bluing, proceed as follows: Dissolve 217 parts of potassium ferro-cyanide ("yellow cyanide") in 750 parts of distilled (or clean rain) water, and add distilled water until the solution makes 1,000 parts by volume. In another vessel dissolve 100 parts of ferric chloride in 750 parts of distilled (or clean rain) water, and also bring up to 1,000 parts, by volume. Make a cold saturated solution of sodium sulphate in distilled water, and of this solution add 2,000 parts to each of the foregoing solutions (thus making 3,000 parts of each). Now, to the ferro-cyanide mixture add the ferro-chloride, slowly, little by little, under constant stirring, which should be continued for a few minutes after the last of the mixture is added. Filter the resultant mixture, and wash the precipitate on the filter with cold distilled water until the wash-water comes off a fine blue color, then spread the precipitate out to dry. The resultant chemical is soluble Prussian blue, completely soluble in water in all proportions, and may be used for all purposes for which the far more costly indigo carmine is usually used. The addition of a little mucilage to an aqueous solution of it converts it into a brilliant blue writing ink. The price of liquid bluing made from it depends, of course, upon the amount of water used in dissolving it, a good formula being about five drachms to the gallon of soft water.

A cheaper article may be made by using Tieman's soluble blue in the following proportion:

Soluble blue	8 parts.
Oxalic acid	2 parts
Water, q. s. to make by volume	1,000 parts

The price of soluble blue is now so cheap that, unless you have extra facilities and plenty of spare time, it will pay you to buy the latter in bulk (costing from $45 to $47 per cwt.).—Nat. Druggist.

Luminous Paint.—The process depends on the property, possessed by certain substances, of absorbing light during exposure to sunshine or other very powerful sources of light, and giving it off again in the darkness, a property which is sometimes, though incorrectly, called "phosphorescence." The list of substances possessing this property in a greater or less degree is a long one, and among them the earthy sulphates and sulphides stand pre-eminent. Numerous processes have been devised for the utilization of this property, all of them, we believe, covered by patents. One of the first of these was Balmain's process, which consists of a luminiferous substance introduced into ordinary paints. This substance is prepared by heating together certain mixtures of lime and sulphur, and the production of calcium monosulphide. Another French patent rests on the calcination of sea-shells (such as those of the oyster, clam, and other bivalves, cuttlefish bone, etc.) in the presence of sulphur, and the addition to the product of various monosulphides (i. e., calcium, barium, strontium, uranium, magnesium, aluminium, etc.).

The following is a practical method of procedure: Clean a quantity of oyster or mussel shells by washing them in warm suds, rinse in running water, then put them in an open fire and heat them for 30 to 35 minutes, then remove and let cool. When cold, pound them and remove carefully all gray portions, as they are of no use. Put the remaining portion in a crucible, making a thin layer of the burnt shell, and putting on top of it a layer of flowers of sulphur, and thus alternating until the crucible is nearly full. Screw on the lid and lute to place tightly with a paste of sand mixed with beer. When this is thoroughly dry put the crucible in a hot fire and heat for an hour. Withdraw the heat, let the crucible cool down spontaneously and when quite cold remove the top. If the operation has been properly conducted the contents will be a white powder. All gray bits that are still found should be removed, as they only serve to weaken the luminosity of the product. Now, sift the powder through a muslin sieve, raking it until only a few coarse bits remain. The sifted powder mix with gum water and apply a thin layer of it to a cardboard, or other surface. When dry apply another thin layer, let dry and expose to strong sunlight for several hours. The surface will acquire a strong luminosity which, when fresh, will last all night.

There are several other processes, all more or less complicated, but this will illustrate the principle involved. You can, we believe, purchase the luminous powders or dry paints ready prepared, though just who has them we are not at present informed.—Nat. Druggist.

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TABLE OF CONTENTS.

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